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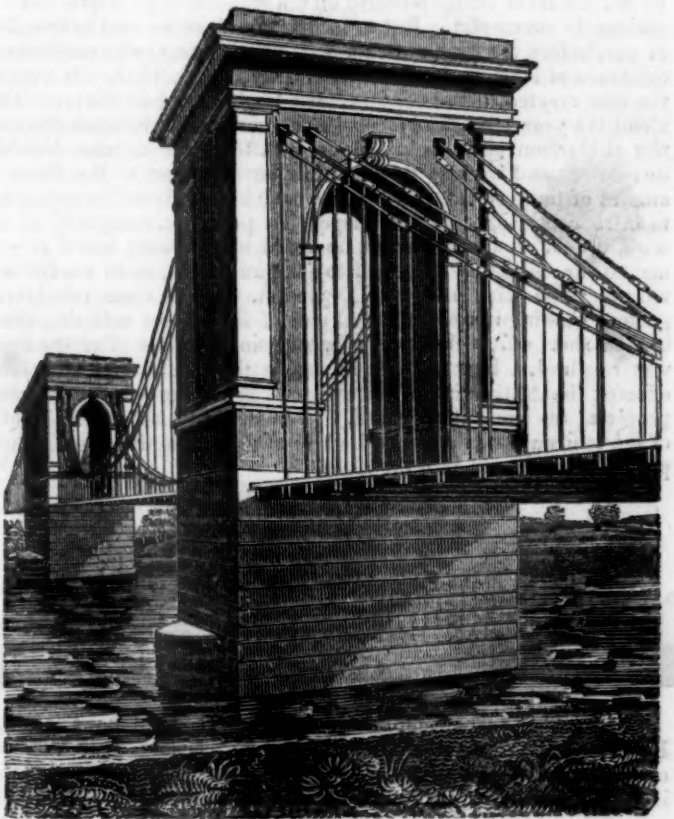
DEVOTED TO THE USEFUL ARTS,

Internal Improvements, and General Science.

APRIL, 1828.

A Perspective View of the Suspension Bridge at Hammersmith.



Descriptive account of the Suspension Bridge now erecting at Hammersmith, near London. By Mr. C. Davy, *Professor of Drawing.*

Iron bridges, the invention of which is due to British ingenuity, are entirely the production of modern times. The first bridge was erected by Mr. Darby, over the river Severn, at Colebrook Dale, and affords a splendid example of the art, and of the engineer's talents. In 1808 an iron bridge was constructed at Staines, but by some unforeseen circumstance, the arch received so much damage, by settlement, that it was found necessary to remove great part of the iron work, and shore the remainder up by piers, constructed of wood. About this time, another iron bridge, erected over the river Tees, gave way; but this, instead of yielding gradually, as the bridge at Staines had done, suddenly broke down and fell into the river. Through the perseverance and talent, however, of Captain Brown, R. N., the art of bridge building on the suspension principle, has been eminently successful. But suspension bridges are said to have been in use, before the time of Scamozzi, the architect, who mentions the existence of them in his work, Del Idea Archi, 1615. It appears, the first erected in this country, [England,] was over the river Tees, about the year 1741, and formed a communication between the counties of Durham and York. Since that time, the number has been increasing; and we may now boast of having some of the finest examples of these structures. These have been followed by an attempt to introduce bridges on the suspension principle, composed of iron wire, which, on a small scale, no doubt will answer; but if of great magnitude, vibration is caused to such an extent, as to render them unsafe. The wire bridge of Dryburgh, through some mischievous persons shaking it violently, had one of the largest radiating chains broken short off, at the point of suspension: shortly after the injury was repaired, a high wind again broke the chains, and completely effected the destruction of the bridge. From the evidence of many people at the time, it appeared, that in this gale, the vertical motion of the roadway, was equal to its lateral motion, and was sufficient to precipitate a person into the river.

Fig. 2.

The iron-bar suspension bridge now erecting over the Thames, at Hammersmith, may justly vie, in point of beauty, with the most celebrated of these structures. The clear extent of the water-way, is 400 feet, from which the road-way rises 16 feet; the points of suspension are built of stone, and designed as archways of the Tuscan

order, flanked by pilasters; and the part near the water is boldly rusticated; these supports are 50 feet high from the road, the thickness is 22 feet; on either end of the bridge, at its entrance, are octagonal lodges, from which project, to a small distance, dwarf walls, terminated by short circular-headed piers, as shown in the elevation, fig. 2. At a great depth behind these piers, the ballast plates, O, fig. 3, are fixed.

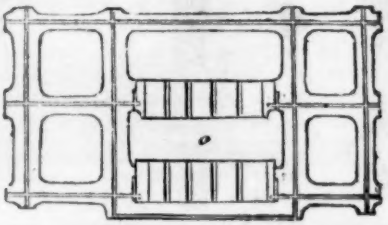


Fig. 3.

The principle of construction is as follows:—D D, fig. 4, are the suspension chains, which consist of bars of iron, 5 inches deep, by one in thickness; these are 10 feet in length, and are connected together, as shown in the annexed plan, by plates of iron, having a strong bolt passing through, and turned at the ends; these plates are placed alternately on the lower and upper chains, by which means a suspension rod, *c e*, $1\frac{1}{4}$ in. thick, occurs at every 5 feet, and these saddle pieces, or plates, (1 and 2, fig. 5,) at every 10 feet, on the lower and upper chains; the plates of the upper chain standing exactly half way between the plates of the lower chain. The suspending rods are furnished with a joint, where they are inserted into the opening, between the chains or plates, enabling them to accommodate themselves to any extraordinary weight on the bridge. There are two pairs of chains on each side of the bridge; the inner pair consists of six links, the outer ones have only three links each, (as represented in figure 5.) At the height of about 39 or 40 feet, from

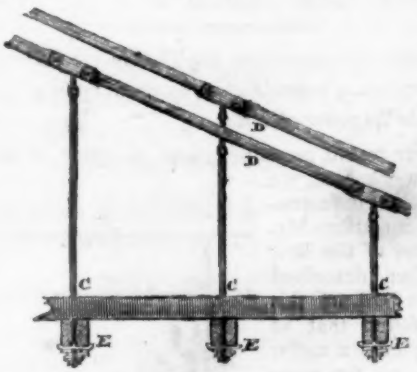
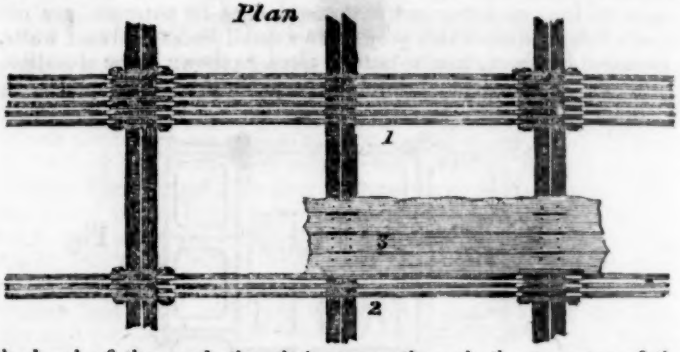


Fig. 4.

Fig. 5.

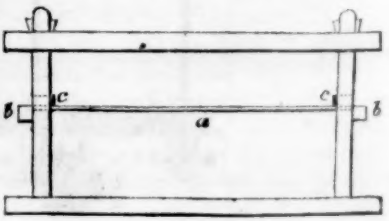


the level of the road, the chains pass through the masonry of the arches before mentioned, and over friction rollers connected to heavy cast-iron plates; the catenarian curve drops in the centre of the bridge, to about the height of a parapet: the spaces between the suspension rods will, eventually, be filled with an ornamental meshing. The road-way consists of transverse beams in two thicknesses, $4\frac{1}{4}$ by 12 inches, with an interval of $2\frac{1}{4}$ between them; these are fastened at the bottom by keys, to strong iron plates; along each side of the bridge, extend a pair of strong beams, which are firmly bolted to the flooring joists; this connexion is shown at *e e*, fig. 4. The road-way of the bridge is slightly raised towards the centre of the river, and the whole is boarded longitudinally with 3 in. planks, (as shown at 3,) with a small space left between each, to prevent any water from settling upon the bridge.

The architectural beauty given to the masonry of this bridge, is a decided improvement on the hitherto clumsy masses of stone, introduced in other erections of this description, and forms a highly ornamental appendage to the river Thames. [*Register of Arts.*

Account of some experiments on the Transverse Strength of Timber; and a description of a new Rafter, invented by Mr. Smart. *By the Editor of the Register of Arts.*

In one of our recent perambulations, in quest of new discoveries in practical mechanics, we happened to call at the manufactory of the ingenious Mr. Smart, inventor of the bow and spring rafter, (described at vol. i. page 315, of this work,) and found that he had just completed a rafter 56 feet long, on the same principle, but of improved



construction. Some time ago, Mr. Smart was induced to institute a series of experiments on the strength of materials, from a doubt which he entertained, of the correctness of the results of Belidor's experiments, on the transverse strength of timber, where it is stated, that the strength of a beam is increased by fastening its ends, so as to prevent their approach when a load is placed in the middle, in the proportion of three to two. To ascertain the correctness of this, Mr. Smart placed a lath *a*, an eighth of an inch thick, into a strong frame, as shown by the annexed cut, which broke with a load of eleven pounds, placed on its middle. He next took a lath of the same wood, of equal dimensions, and fixed it firmly at the ends, by means of the projecting pieces *b b*, and the wedges *c c*, and ascertained that it would sustain by this arrangement, the enormous load of 270 pounds: hence it appears that the strength of a lath is increased, between twenty-four and twenty-five times, merely by securing it well at the ends.

This important discovery was turned to account by Mr. Smart, in the construction of rafters, which he denominates *bow* and *string rafters*. He considered that the principal defect in fixing the ends of rafters, was the want of sufficient stability in their supports, and he has contrived to make the abutments within the rafter itself, and thus to take advantage of the longitudinal strength of the timber, as represented in the annexed figure. This rafter, which is 56 feet between the bearings, is made out of a scantling 10 inches by 4 inches. An incision is made by a circular saw from the middle nearly to each end: a transverse cut is then made at *a*, through the middle of the upper part of it; and at each end *b b*, of the incision, a transverse piece, of a wedge shape, is cut out, reaching nearly to the longitudinal incision, but not so near as to separate the parts.

Roofs, constructed on this principle, possess many advantages, among which may be enumerated their extreme lightness, their flatness, and the economy of their erection: and we think the invention may be safely characterized as one of the most important and valuable in the art of building in modern times.

On the Preparation of Enamel Colours and Fluxes; and the vehicles for laying them on. By MR. ROBERT WYNN.

[Concluded from p. 172.]

YELLOW ENAMELS.

Red lead - 8 parts, Oxide of antimony 1 part,
White oxide of tin 1 part.

Mix the ingredients well in a biscuit-ware mortar; and having put them on a piece of Dutch-tile in the muffle, make it gradually red-hot, and suffer it to cool.

Take of this mixture 1 part, Of Flux, No. 4, $1\frac{1}{2}$ parts.
Grind them in water, for use.

By varying the proportions of red-lead and of antimony, different shades of colour may be obtained.

Another Yellow Enamel.

Take three parts, by weight, of sheet-lead, and one part of block-tin; melt them together in a ladle or a flat shovel, and skim off the top as fast as it oxidates. When a sufficient quantity is thus obtained, place it in the muffle, in a gentle reverberating heat, to calcine any remaining particles of metal:*

Of which, take - $7\frac{1}{2}$ parts, Oxide of antimony, 1 part,
Litharge, - 1 part.

Mix these well together, and give them a red heat in a muffle, sufficient to bind them together, but not to melt them. Use the same flux as for the other yellow.

Orange Enamel

Take red lead, 12 parts, Red sulphate of iron, 1 part,
Oxide of antimony, 4 parts, Flint powder, - 3 parts;
well mixed together in the mortar, and heated, so as to adhere together, but avoid melting.

Take of the above, 1 part, Flux, No. 7, - $2\frac{1}{2}$ parts.
Grind for use.

Dark Red Enamel.

Brown sulphate of iron, 1 part, Flux, No. 7, - $2\frac{1}{2}$ parts.
Grind for use.

Light Red Enamel.

Red sulphate of iron, 1 part, Flux, No. 1, - 3 parts,
White lead, - $1\frac{1}{2}$ parts.
Grind for use.

Red Brown Enamel.

Brown sulph. of iron, 1 part, Flux, No. 1, - 3 parts.
Grind for use,

Vandyke Brown Enamel.

Flux, No. 4. - 3 parts, Iron filings, - 1 part,
melted together in a crucible, and drawn out with tongs;† with so much metal it will not pour out freely.

* This, after being finely ground, forms the *putty* so much used in polishing steel, &c.

† In this, and in other cases where a muffle is not in readiness, an earthen crucible, washed over with flint powder inside, or with dry flint powder rub-

Take of the preceding, 5 parts, Black oxide of cobalt, 1 part.
Grind for use.

Another Brown Enamel.

Manganese, - 2½ parts, Red lead, - 8½ parts,
Flint powder, 4 parts.
Heated, so as to stick together.
Of this mixture take, 1½ parts, Flux, No. 4, - 1 part,
Iron filings, - 1½ parts.
Grind for use.

Black Enamel, for Painting, and mixing with other Colours.

Umber, broken into small pieces, and calcined in a yellow heat, in a crucible, till quite black, then washed in boiling water and dried:
Of this take 10 parts, Black oxide of cobalt, 10 parts,
Blue flint glass, 10½ parts, Borax, uncalcined, 7½ parts,
Red lead, - 12 parts.
Heat these well together.
Take of the above, 2 parts, Flux, No. 4, - 1 part.
Grind in water for use.

Blacks are compounded in other proportions of these ingredients, and manganese is sometimes substituted in the place of umber.

Another Black Enamel.

Umber, calcined black, 1 part, Black oxide of copper, ½ a part,
Black oxide of cobalt, 1½ parts, Flux, No. 4, - 3 parts.

Grind these in water, and, when dried, place them on a piece of Dutch tile, (previously washed over with flint powder, ground in water,) in a muffle, in a charcoal fire, and heat them so as to bind together; then add half a part of Flux, No. 4.

These blacks, if too soft, are hardened by adding a little black oxide of cobalt.

Black Enamel for Shading, and Drawing under the Greens

Manganese, - 5 parts, Royal smalt, - 1 part,
ground fine in water, and heated to a high degree in a muffle.

Beautiful Black Enamel, for Solid grounds, or Inlaying, but does not mix generally.

Black oxide of copper, 1 part, Flux, No. 4, - 2 parts.
Grind in water for use.

A Frit, for Transparent Green Enamels.

Flint powder, - 3 parts, Flux, No. 2, - 3 parts,

bed inside of it, one-eighth of an inch in thickness, may be used; and the materials, when partially melted, so as to bind together, may be then entirely taken out without loss.

Green pot-metal glass, 1½ parts, Red lead, - - 7½ parts,
Borax, uncalcined, 2½ parts, Green oxide of cop. 1¼ parts.
Melt them in a crucible, pour out the mass, and powder it in an earthenware mortar.

Green Enamel.

Take of the green frit, 3 parts, Of yellow enamel, 1½ parts.
If too soft, add Naples yellow.
Grind in water for use.

Another Green Enamel.

Green frit, - 3 parts, Flux, No. 2, - ½ a part,
Flux, No. 6, - 2½ parts.
Grind in water for use.

Greens, for painting in enamel, are formed of various shades, by mixing blue and yellow, blue and orange, &c. in different proportions.

Blue Enamel.

Black oxide of cobalt, 4 parts, Flint powder, - 9 parts,
Nitre, - - 13 parts.
Mix the ingredients well in an earthenware mortar, and heat them in a crucible, in a strong fire of coke and charcoal, till perfectly melted;* then powder the mass, wash it in cold water, and dry it.
Of this, take - 1 part, Flux, No. 5, - 1 part.
Grind in water for use.

Another Blue Enamel.

Black oxide of cobalt, 1 part, Borax uncalcined, 1 part.
Melt them together.
Of this mixture take, 2 parts, Blue pot-metal glass, 10 parts,
Red lead, - - ½ a part.
Melt them in a very strong fire. If either blue is too soft, add a little royal smalt; if too hard, a little flux, made of
Blue glass, - 2 parts, Borax, - 1 part.

Purple Enamel.

Take fine gold from the refiners, and dissolve it to saturation in an aqua-regia made as follows:
Of the strongest nitric acid, 1 part, by measure,
Muriatic acid, - 3 parts, Distilled water, - 3 parts.

Make the solution in a clean Florence oil-flask, placed on sand near the fire. Pour melted tin into cold water, to granulate it, and dissolve it to saturation in diluted aqua-regia, 4 parts. Place the

* If these preparations are not sufficiently fluid, in the melted state, to pour out of the crucible, the colour will adhere to a piece of steel bar, when it is warm, and may be drawn out; and sometimes the blues are made in crucibles lined with flint powder, as before mentioned.

tin and the acid in a large basin, covered with an earthen plate, in a temperate heat: when the tin is all dissolved, add still more tin, and also strong red fuming nitrous acid 1½ parts; and again dissolve the tin to saturation, covering the basin with the plate, to prevent the fumes from escaping. After standing twenty-four hours, a little distilled water should be poured into the basin. The solution of tin may then be put into a clean phial, for use, adding to it a few grains of tin; examine it, after four or five days, when the solution, if carefully made, will be of a fine clear dark colour, and fit to make purple with.

Then, of the solution of gold, take sufficient to make distilled water of a faint yellow colour, and drop gradually into it the solution of tin, till the last added drops occasion no turbidness in the liquor, and a most beautiful purple precipitate will immediately be formed, which must be thrown, as it is made, into a large vessel, and two or three pieces of the granulated tin should be put at the bottom of the vessel. The precipitate is then to be washed in several hot waters, filtered on the blotting paper and canvass, and, while in a moist state, is to be mixed with the flux, No. 4, finely powdered.

The proportion of the flux to the purple precipitate, is always various, and is judged of by the mass being of a good, rich, dark colour, as the ingredients are ground together on the plate-glass. Care must be taken to grind this colour before it gets dry.

Twenty-four grains of gold made into a precipitate in this manner, will take two ounces of flux; and this may be a rule to the inexperienced practitioner.

Rose-coloured Enamel.

To a saturated solution of gold in aqua-regia, (containing twenty-four grains of gold,) diluted with 100 times its bulk of warm distilled water, having 20 grains of alum* dissolved in it; add caustic ammonia, drop by drop, as long as any precipitate is thrown down, which precipitate wash in several hot waters.

To 24 grains of gold, precipitated in this manner, add

Flux, No. 4, - 2 ounces. Flux, No. 3, - 2 ounces.

Mix them together wet, and grind them on a plate-glass, adding, by a leaf at a time, 16 leaves of leaf-silver: when the whole is ground fine, let it be dried on the glass, scraped off, and put into a bottle for use.

This rose-colour grinds of a gray, or slate colour; but, after being ground, if it be placed in a muffle, and exposed to a gentle heat, it will turn to a red colour: it is fit for use in either state.

If too yellow, add a little purple; and if too purple, add more leaf-silver.

Another Rose-coloured Enamel.

Take purple, made as before directed, - - 1 ounce.
Flux, No. 3, - 4 ounces. Muriate of silver, 10 grains.

* The rose-colour is sometimes made without any alum.

The latter ingredient is prepared, by dissolving silver in aqua-fortis, and precipitating it with common salt.

Grind in water for use. If too purple, add more muriate of silver.

Opaque White Enamels.

Hartshorn shavings, burnt in a crucible, in a charcoal fire, till perfectly white, - 1 part. Flux, No. 1, - 1 part.
Grind in water for use.

Venetian white cake enamel, 1 part. Flux, No. 8, 1 part.
Grind in water; then heat them together in a muffle.

Flux, No. 2, powdered and washed, then dried and heated in a muffle.

It would not be difficult to exhibit a multitude of specimens of different tints, and to fill a volume with descriptions of them, merely by combining these original enamel colours in various proportions: this, however, may safely be left to the taste and experience of the artist. My object has been, to avoid every thing superfluous; and, at the same time, to explain the processes adapted to immediate practice, in terms not liable to be mistaken.

Account of some of the Processes in the Manufacture of Edge Tools and other Steel Instruments. *By* Samuel Parkes, F.L.S., &c.

[Concluded from p. 201.]

In the year 1789, Mr. David Hartley took out a patent for a method of tempering steel by the aid of a pyrometer or thermometer, applied near to the surface of the article, and at the same time recommended the use of heated oil, in which he says many dozens of razors, or other tools, might be tempered at once with the utmost facility, and the various degrees of heat necessary for the different purposes might speedily be determined by experiment.

When I first saw this announced in the public journals, it immediately occurred to me that the principle might be improved upon, and if a bath of oil, or of some kind of fusible metal, were contrived for the tempering of every species of edge tool, that a greater degree of certainty would be given to this operation, than the persons who have generally the conduct of such manufactories have ever experienced.

Influenced by these views of the subject, I determined long ago, that I would embrace some opportunity of instituting a series of experiments, to determine at what degrees of temperature all the common kinds of oil enter into ebullition, and also the melting points of several metallic compounds, in order to be able to furnish the practical cutler with a few tables, from whence he might learn how to construct a bath, in which he could at all times impart the desired temper to the particular instruments of his manufacture, with the utmost certainty, and with unusual despatch. These expe-

riments have been performed, and those results which were deemed most important will be given in a tabular form in the appendix to this volume.

In the application of this principle of tempering edge tools in a fluid menstruum, whether metallic or otherwise, it will be adviseable to have the bath which is to contain the heated fluid, made of cast-iron, which should vary in form and size, so as to adapt it to the particular sort of tools or instruments which are to be tempered within it. And where the business is considerable, it would be convenient to have two such baths fixed in brickwork, adjoining to each other, and heated by the same fire, with registers to cut off the communication of either of them with the fire-place at pleasure, so that one might be heating while the workman was tempering his goods in the other.

Many advantages would result from this method of tempering edge tools. In the first place, there could never be any uncertainty as to the degree of temper which the articles would acquire; for, when the manufacturer had once ascertained which of the metallic baths was suitable for any particular kind of edge tool, all that would be necessary would be to arrange the goods in rows upon the surface of the congealed metal, to light a fire underneath the containing vessel, and then carefully to observe when the surface of the fusible metal begins to melt. As soon as this takes place, the edge tools are immediately to be removed and plunged into cold water, by which means the whole parcel will have acquired exactly the same temper.

Secondly, where instruments have a thick back and a fine edge, it is almost impossible ever to give them a uniform temper by the old method; for there will always be a danger of the edge being lowered too much before the other parts become regularly heated throughout. This difficulty occurs particularly in razors, where the thickness of the back is always a formidable obstacle to the attainment of a uniform regularity of hardness. It may, however, be determined by means of nitric acid, whether a razor or other polished edge tool be of an equal degree of hardness: for, on applying this acid to bright steel, the black tinge will appear more speedily and strongly upon the hard parts than on the rest of the surface.

Formerly, no man in Great Britain knew how to temper a sword in such a way that it would bend for the point to touch the heel and spring back again uninjured, except one Andrew Ferrara, who resided in the Highlands of Scotland. The demand which this man had for his swords was so great, that he employed workmen to forge them, and spent all his own time in tempering them; and found it necessary, even in the day-time, to work in a dark cellar, that he might be better able to observe the progress of the heat, and that the darkness of his workshop might favour him in the nicety of the operation. Had this ingenious artist thought of a bath of oil, he might have heated this by means of a furnace underneath it, and by the use of a thermometer, to the exact point which he found necessary; though it is inconvenient to have to employ a thermometer for every

distinct operation. Or, if he had been in possession of a proper bath of fusible metal, he would have attained the necessary certainty in his process, and need not have immured himself in a subterranean apartment.

The swords which were formerly in the highest repute, were made at Damascus in Syria. The method by which these were made, has long been lost; or perhaps it was never thoroughly known to Europeans; but it is supposed that they were formed by alternate layers of extremely thin plates of iron and steel bound together with iron-wire, and then firmly cemented together by welding. These weapons never broke, even in the hardest conflict, and yet they retained so powerful an edge, that the armour made like net-work with scales of iron, or with small iron rings, called coats of mail, was instantly divided under their force.

This manufactory at Damascus had formerly the greatest reputation throughout Europe, and through a great part of Asia; but in the latter end of the fourteenth, or at the beginning of the fifteenth century, Timour Bec, usually called Tamerlane, on his conquest of Syria, carried away all the best workers in steel from Damascus to Persia, and we know so little of Persia, that it may be difficult now to ascertain whether this peculiar manufactory is still carried on in that country or not.

A writer in Nicholson's Journal, who had the opportunity of examining a real Damascus blade, which had cost the possessor twelve guineas at Constantinople, has thus described it: "It had (says he) a dull gray or bluish appearance, was scarcely harder than common steel from the forge, was not easily bended, and when bended had no spring to recover its figure. Its back was smooth, as were also two narrow sloped surfaces which formed its edge under an angle of about 40 degrees; but its flat sides were every where covered with minute waving lines in masses in all directions, not crossing each other, and, for the most part, running in the direction of its length. The lines were in general as fine as harpsichord wire, not extremely well defined nor continued; and their distinction from each other was effected by no perceptible indentation of the surface, but rather by the succession of parts differing in the degree of polish or brightness."

"I was informed," says the writer of the memoir, "that if any part of this blade were made smooth by grinding or whetting, the wavy appearance, called the water, could be again produced by means of lemon juice; and that its excellencies were, that it could be depended upon not to break; and that it would cut deeper into a soft substance, such as a pack of wool, or into flesh, than any other kind of sword blade."

"I infer, therefore," adds the writer, "that the Damascus steel is in fact a mechanical mixture of steel and iron; that it is incapable of any considerable degree of hardness, and consequently is in no danger of breaking from its brittleness; that its tenacity is ensured not only from the admixture of iron, but likewise from the facility with which its soundness may be ascertained throughout, by

the same process which exhibits the water or fibrous appearance; and, lastly, that the edge of a weapon formed of this material must be rough, on account of the different resistance which the two substances afford to the grindstone, in consequence of which it will operate as a saw, and more readily cut through yielding substances than such cutting tools as are formed of a more uniform substance."

The conjectures of this writer respecting the methods by which these blades were manufactured at Damascus, and the account of the experiments which he himself undertook for the purpose of enabling him to imitate them, are extremely interesting and instructive, so much so that I have no hesitation in recommending the whole paper to the perusal of all those who are curious in the manufacture of edge tools.

I would not have it understood that I wish to lay any claim to the merit of the discovery of metallic baths for the tempering of edge tools, because I know of two or three individuals who, for some particular articles, have for several years adopted this expedient; but I have reason to believe that the few cutlers who have been in the habit of tempering in a fluid bath, have always employed a thermometer; whereas the object of my experiments is to furnish a list of baths, either of which may be used with certainty, without employing that instrument. Moreover, as the practice is very much confined, and few workmen, comparatively, have any idea that it would be possible to render such a method available, I was desirous of explaining its principles, and of furnishing a scale by which the manufacturer might acquire the means of tempering any instrument whatever, in such a manner as will render it entirely suitable to the purpose for which it is intended.

Another kind of edge tool remains to be described, which is made of *cast-iron*, and afterwards converted into steel. The method of conducting this process was discovered by Mr. S. Lucas, of Sheffield, and he has obtained a patent for the invention.

The invention by Mr. Lucas, of converting edge tools made of cast-iron into good steel, appears to be an important improvement. It consists in stratifying the cast articles, in cylindrical metallic vessels, with native oxide of iron pulverized, or sand containing oxide of iron, and then submitting the whole to a regular heat in a furnace built for the purpose. It is not necessary that the oxide employed should be a *native* oxide, any artificial oxide being equally effective; that kind which can be had cheapest is therefore generally preferred. The operation may be thus explained:—

The cast-iron of which this cutlery is made, is brittle in the first instance, like other cast-iron, in consequence of the carbon contained in it; but the great heat which it undergoes, aided by the pulverized oxide, separates the carbon: this uniting with the oxygen of the ground oxide of iron, is dissipated in the state either of carbonic oxide or carbonic acid gas, and the goods are then converted into a state very similar to that of good cast-steel cutlery.

To prevent misconception, it may be necessary to state, that cast-iron which contains a *large* proportion of carbon is less brittle than

that which is combined with a smaller quantity. It can also be filed and cut with a cold chisel, while the latter, although it can be more readily broken, effectually resists the action both of the chisel and the file. In conformity with these facts, small machinery made of common cast-iron may be softened merely by cementation with a carbonaceous substance, thereby augmenting its dose of carbon, and rendering it capable of being smoothed by the file.

I understand that the best pig-iron is always chosen for making the various articles of cutlery, while the poorest iron ore, if free from sulphur, may be pulverized and stratified with them to afford oxygen.

After several years' experience, Mr. Thomas Lucas has been enabled to bring this process to such a state of perfection, that his cast cutlery will bear a polish equally brilliant with the best cast-steel goods, as I can testify from my own observation; and will also take as fine an edge, so that some of the best judges of cutlery cannot distinguish the difference. When, however, the cast cutlery wares, which have been thus annealed, are submitted to the usual processes of hardening and tempering, they are apt to be more brittle than those edge tools which are made in the usual way with the best steel.

It has also been found that by varying the process, small pig-iron castings can be converted into good malleable iron: in consequence of this, the patentee now makes a great variety of small iron utensils by *casting*, which were formerly made only on the anvil of the blacksmith; and when he has converted the metal to the quality of soft malleable iron, these articles are found to be equally fit for a great variety of purposes, and can be afforded at a much lower rate than similar goods which have been modelled by hand, as heretofore. He has become so complete a master of this business, that he can convert cast-iron goods either into the state of wrought iron or steel at pleasure.

ACTIVE AND PASSIVE STRENGTH.

Active Strength, or Animal Energy of Men, Horses, &c.

[From Gregory's Mathematics for Practical Men.]

[CONTINUED FROM PAGE 198.]

17. Among quadrupeds, those which are employed to produce a mechanical effect are, the dog, the ass, the mule, the ox, the camel, and the horse. Of these the *horse* is the only one, so far as we are aware, whose animal energy has been subjected to cautious experiments; and even with regard to this noble animal, opinions as to actual results are very much afloat. The dynamic effort of the horse is, however, probably, about 6 times that of a strong and active labourer. Desaguliers states the proportion as 5 to 1, coinciding with the deductions of Smeaton. The French authors usually regard 7 men as equivalent to one horse. As a fair mean between these, I assumed in vol. I. of my *Mechanics* the proportion of 6 to 1, and stated the strength of a horse as equivalent to 420 lbs. at a dead

pull. But the proportion must not be regarded as constant; but, obviously, varies much, according to the breed and training of the animal, as well as according to the nature of the work about which he is employed. Thus the worst way, as De la Hire observed, of applying the strength of a horse is to make him carry a weight up a steep hill; while the organization of a man fits him very well for that kind of labour: hence *three* men climbing up such a hill with a weight of 100 lbs. each, will proceed faster than a horse with a load of 300 lbs.

18. In the memoirs of the French Academy for 1703, are inserted the comparative observations of M. Amontons, on the velocity of men and of horses; in which he states the velocity of a horse loaded with a man and walking to be rather more than $5\frac{1}{4}$ feet per second, or $3\frac{1}{2}$ miles per hour, and when going a moderate trot with the same weight to be about $8\frac{1}{2}$ feet per second, or about 6 miles per hour. These velocities, however, are somewhat less than what might have been taken for the mean velocities.

19. But the best way of applying the strength of horses is to make them draw weights in carriages, &c. To this kind of labour, therefore, the inquiries of experimentalists should be directed. A horse put into harness and making an effort to draw, bends himself forward, inclines his legs, and brings his breast nearer to the earth; and this so much the more as the effort is the more considerable. So that when a horse is employed in drawing, his effort will depend, in some measure, both upon his own weight and that which he carries on his back.

Indeed, it is highly useful to load the back of a drawing horse to a certain extent; though this, on a slight consideration, might be thought to augment unnecessarily the fatigue of the animal: but it must be recollected that the mass with which the horse is charged vertically is added in part to the effort which he makes in the direction of traction, and thus dispenses with the necessity of his inclining so much forward as he must otherwise do: and may, therefore, under this point of view, relieve the draught more than to compensate for the additional fatigue occasioned by the vertical pressure. Carmen, and wagoners in general, are well aware of this, and are commonly very careful to dispose of the load in such a manner that the shafts shall throw a due proportion of the weight on the back of the shaft horse.* This is most efficaciously accomplished at Yarmouth, in Norfolk, where a number of narrow streets connecting the market-place with the quay, have led to the invention and use of the low, strong, narrow carts, thence denominated *Yarmouth carts*, drawn by one horse; and on which the loads are frequently shifted, especially when the vehicles pass over the bridge, in order to give the animals better foot-hold, and consequently a greater dynamic effort.

20. The best disposition of the traces during the time a horse is drawing is to be perpendicular to the position of the collar upon his

* How *wagoners* can do this, we think it would puzzle the learned author to explain.—*Editor.*

breast and shoulders: when the horse stands at ease, this position of the traces is rather inclined upwards from the direction of the road; but when he leans forward to draw the load, the traces should then become nearly parallel to the plane over which the carriage is to be drawn; or, if he be employed in drawing a sledge, or any thing without wheels, the inclination of the traces to the road, should (from careful calculation) be about $18\frac{1}{4}°$, when the friction is one-third of the pressure.

21. When a horse is made to move in a circular path, as is often practised in mills and other machines moved by horses, it will be necessary to give the circles which the animal has to walk round the greatest diameter that will comport with the local and other conditions to which the motion must be subjected. It is obvious, indeed, that, since a rectilinear motion is the most easy for the horse, the less the line in which he moves is curved, with the greater facility he will walk over it, and the less he need recline from a vertical position: and besides this, with equal velocity the centrifugal force will be less in the greatest circle, which will proportionally diminish the friction of the cylindrical part of the trunnions, and the labour of moving the machine. And, further, the greater the diameter of the horse-walk, the nearer the chord of the circle in which the horse draws is to coincide with the tangent, which is the most advantageous position of the line of traction. On these accounts it is that, although a horse *may* draw in a circular walk of 18 feet diameter, yet in general it is adviseable that the diameter of such a walk should not be less than 25 or 30 feet; and in many instances 40 feet would be preferable to either.

22. It has been stated by Desaguliers and some others, that a horse employed daily in drawing nearly horizontally can move, during eight hours in the day, about 200 lbs. at the rate of $2\frac{1}{2}$ miles per hour, or $3\frac{2}{3}$ feet per second. If the weight be augmented to about 240 or 250 lbs., the horse cannot work more than six hours a day, and that with a less velocity. And, in both cases, if he carry some weight, he will draw better than if he carried none. M. Sauveur estimates the mean effort of a horse at 175 French, or 189 averd. pounds, with a velocity of rather more than three feet per second. But all these are probably too high to be continued for eight hours, day after day. In another place, Desaguliers states the mean work of a horse as equivalent to the raising a hogshead full of water (or 550 lbs.) 50 feet high in a minute. But Mr. Smeaton, to whose authority much is due, asserts, from a number of experiments, that the greatest effect is the raising 550 lbs. forty feet high in a minute. And, from some experiments made by the Society for the Encouragement of Arts, under the direction of Mr. Samuel Moore, it was concluded, that a horse moving at the rate of three miles an hour can exert a force of 80 lbs. Unluckily, we are not sufficiently acquainted with the nature of the experiments and observations from which these deductions were made, to institute an accurate comparison of their results. Neither of them ought to express what a horse can draw upon a carriage; because in that case friction only is to be

overcome (after the load is once put into motion); so that a middling horse, well applied to a cart, will often draw much more than 1000 lbs. The proper estimate would be that which measures the weight that a horse would draw up out of a well; the animal acting by a horizontal line of traction turned into the vertical direction by a simple pulley, or roller, whose friction should be reduced as much as possible.

23. Mr. Tredgold, in his recent publication on Rail-roads, has directed his attention to the subject of "*horse power.*" We have already quoted his expression for the power of a horse, $250\ v\left(1-\frac{v}{\mathrm{v}}\right)$ and $\frac{250\,d\,v\left(1-\frac{v}{\mathrm{v}}\right)}{1+n}$ for the day's work in lbs. raised one mile; d being the hours which the horse works in a day, and the weight of the carriage to that of the load as $n:1$. He also gives $\frac{14{\cdot}7}{\sqrt{d}}$ for the greatest speed in miles per hour, when the horse is unloaded. These expressions must, at present, be regarded as tentative; and with all our respect for that truly ingenious and indefatigable author, we, as yet, suspend our judgment in reference to their perfect accuracy. But Mr. Tredgold is a man of experience as well as of competent science; so that whatever he advances on a subject of mixed research deserves attention. We select, therefore, the following tablet of the comparison of the duration of a horse's daily labour and maximum velocity, unloaded.

Duration of labour. *Hours.*	Max. velocity unloaded in miles per hour.
1	14·7
2	10·4
3	8·5
4	7·3
5	6·6
6	6·0
7	5·5
8	5·2
9	4·9
10	4·6

Taking the hours of labour at 6 per diem, the utmost that Mr. Tredgold would recommend, the maximum of useful effect he assigns at 125 lbs. moving at the rate of three miles per hour, and regarding the expense of carriage, in that case, as unity; then,—

Miles per hour.	Proportional expense.	Moving force.
2	$1\frac{1}{6}$ or 1·125	166 lbs.
3	1	125 —
$3\frac{1}{2}$	$1\frac{1}{35}$ or 1·0285	104 —
4	$1\frac{1}{8}$ or 1·125	83 —
$4\frac{1}{2}$	$1\frac{1}{3}$ or 1·333	$62\frac{1}{2}$ —
5	$1\frac{4}{5}$ or 1·8	$41\frac{2}{3}$ —
$5\frac{1}{3}$	2	$36\frac{1}{2}$ —

That is, the expense of conveying goods at 3 miles per hour, being 1; the expense at 4½ miles per hour, will be 1½; and so on, the expense being doubled when the speed is 5½ miles per hour.

24. Thus, according to Mr. Tredgold, we have for the day of 6 hours 2250 lbs. raised one mile. And Mr. Bevan, who has made many experiments on the force of traction to move canal boats on the Grand Junction Canal, found the force of traction 80 lbs., and the space travelled in a day 26 miles; hence, it is only equivalent to 26 × 80 = 2080 lbs. raised one mile for the day's work; the rate of travelling being 2.45 miles per hour; and the result a little less than Mr. Tredgold's, the difference probably arising from the deviation of the angle of the catenary from the horizon.

[TO BE CONTINUED.]

ON GILDING.

On the Preparation of Gold, and the art of Gilding in Size, Oil, &c.

[Concluded from p. 168.]

Oil-Gilding, to stand the weather.

THE object to be gilt, whether of metal, stone, or wood, must be coated three times over, with a mixture of linseed oil, white lead, and a small quantity of spirit of turpentine: if it be wood, it should be previously rubbed with glass-paper or fish-skin. When the last coat is dry, the work should be gold-sized, thus: take any quantity of the gold-size, described at the end of this article, and, with a common hog's-hair brush, mix it with boiled linseed oil, till it is so thin, that, when a little of it be laid on the work to be gilt, the white paint, before put on, will appear through it; though it must not be made so thin as to lose the tinge of the yellow ochre: then proceed to lay it on sparingly, with fine hog's-hair brushes, proportioned to the size of the parts of the work. When the gold-size is good, it will dry in twelve hours: if laid on in the evening, it will be fit for gilding the next morning. Sometimes, in winter, and when the gold-size is fresh made, it will take two or three days: to prevent this, an expedient, unknown to the generality of gilders, may be used; which is, to mix with it a small quantity of japanners' gold-size: this will hasten the drying: but, in this case, when it begins to have the *tack*, hereafter to be explained, it dries very quickly; therefore great care should be taken to get the gold on as fast as possible. In order to ascertain its fitness for receiving the gold, the work must be touched with the finger: if it feel somewhat adhesive or clammy, but not so as to be brought off by the finger, it has the *tack*, or, in other words, it is in a fit state for gilding; but if it be so clammy as to come off, on being touched, or have any inclination thereto, it is not sufficiently dry: if it have no adhering quality, it is too dry, and must be sized over again before it can be gilt. In laying on the gold, a *tip* is used, which must be previously rubbed with a little tallow, to make it hold; but it must be so little, as to show no ap-

pearance. When the surface to be gilt, whether round, hollow, or flat, is sufficiently large and plain to receive whole leaves, they must be given from the book of gold, which must be held in the left hand, by the part that is sewed, the leaves be turned carefully over, and always be kept so steady, that the gold may be undisturbed and lie perfectly flat. Then take the *tip* in the right hand, and touch the leaf-gold, about half an inch deep on the side opposite to the sewing of the book: both hands must then be moved to the place meant to be gilt. Having laid the edge of the leaf, already attached to the tip, upon the work, which is always considered as having the *tack*, it will be caught and held fast by the gold-size, and the tip will be left at liberty. The book must then be slowly drawn away; followed, as it moves, by the tip; which is now used, gently to press the gold close to the work, until the whole leaf is on: this must be repeated, until those parts which are large enough to receive a leaf, are all gilt. This method is in use with a few of the best gilders, and may be acquired in an hour's practice. For those parts that are too small for the entire leaf, it is necessary to use a cushion; upon which about half a book of gold may be blown out, one leaf at a time; each one being carefully turned, until it lies nearly flat, when, by puffing gently as near as possible on the centre of the leaf, it will become smooth and even, and must be cut into strips, with a knife used for the purpose, according to the widths of the different members and mouldings, and then be laid on with the tip. As the work advances, or when it is gilt all over, the gold must be pressed close with a little cotton; then, be brushed over with a dry, soft, hog's-hair brush, in order to clear away any loose particles of the gold-leaf—one previously used a little in the whitening, will best answer the purpose. If any defective parts appear, those which cannot be mended by pressing upon them the loose gold just brushed off,—which may be done with the brush in hand, or a little cotton,—must be covered in the following manner. Cut a leaf of gold into square pieces, proportioned to the sizes of the defects; and with the camel's-hair pencil, slightly moistening the tip of it, by putting it to the lip, place a piece on each faulty part, which must be again pressed with the cotton. The work is then finished, unless the faulty parts are too dry to receive the gold; when they must be again gold-sized and gilt, as before directed. In general, boys do not acquire the method of using the gold on the cushion, in less than three months; though a person determined to accomplish it, may do so in one week.

Oil-Gilding not to stand the weather.

Picture-frames, and other work in oil-gilding not intended to be exposed to the weather, to be well done, must be prepared, as far as smoothing, in the same way as work to be gilt in burnished gold. When smooth, and after being rubbed with glass-paper, it must be coated twice over with size, rather weaker than that used for whitening;—that which is stale, answers best. The gold-size must be laid on as before directed in oil-gilding; and when the work is gilt, it

must be pressed with the cotton, and brushed over. If faults appear, they must be treated thus: Take a little weak size, as directed in burnish-gilding; coat the work all over, when dry; wet each part, where a fault appears, with clear water, and lay on it a piece of gold, with a camel's-hair pencil, as before directed: this is not to be pressed with the cotton, but gently rubbed with it, when completely dry, which it will be in half an hour, (as will all the coats that are used for gilding, except oil gold-size,) give the work another coat of the weak size; and then one of the clear size, which completes the gilding; but the effect is considerably heightened by a coat of *or-molu*, such as is used to finish the matted parts of the burnished gilding.

To make strong Size.

Take a clean sauce-pan, of any size most convenient: fill it nearly with water: when heated as much as the hand can bear, keep putting in cuttings of parchment, (which best answer the purpose,) or glover's white-leather shreds, pressing them down well with the hand, till they are within an inch and a half of the surface of the water: boil them slowly for an hour and a half, and the strong size will be made: pass it through a hair-sieve, into a pan, and set it aside for use. The same parchment or shreds will again yield the same quantity of size. Stale size becomes putrid, and is unfit for use.

Clear Size

Differs only from the preceding, in these particulars: it must be made in smaller quantities; the parchment or shreds must be washed in several waters, milk warm, till no dirt appears; it should then boil only fifteen minutes; be passed through a finer sieve; and, when reduced, or thinned, care must be taken that the water used, is perfectly clean.

Gold-Size for Burnished Gilding.

Take one pound of pipe-clay: put it into an earthen pan, full of water: when soaked, pour off the water, and grind it on a stone, with a mullar, such as is used by house-painters; now and then, sprinkling it with water, as it becomes dry: care must be taken that no dirt or grease be on the stone or mullar; and as it is ground, put it into another pan. Then, take half an ounce of the best black-lead, the eighth of an ounce of mutton suet; pound them together with the mullar; and then proceed to grind them particularly well, using water, as before directed for the pipe-clay. When ground, put them into a smaller pan. Grind half an ounce of the best red-chalk; and mix the black-lead, suet, and red-chalk well together on the stone, with a pallet-knife; and add to them the clay, until all these ingredients are thoroughly mixed: put them into a covered earthen pan, to prevent dirt or dust from reaching them, and keep them to use as wanted. Ten or twenty pounds may be made at a time. This gold-size must be moistened once a month, or oftener, with clean water, to prevent it from getting dry; in which case it would be necessary

to grind it again. Care should be taken in selecting these ingredients: the best black-lead dust from the saw of the pencil-makers, is most fit for the purpose: it may be had at any respectable shop in that line. In choosing the clay, take that which has the least grit: this may be discovered by putting a little in the mouth, and trying it between the teeth: the darkest is generally the best: the greatest choice of it may be had at the pipe-maker's. The softest red-chalk, such as is used for drawing with, must be chosen; though gold-size may be very well made without any, as its principal use is to heighten the colour of the gold when burnished.

Prepared Pipe-Clay, and Yellow Ochre.

The pipe-clay must be chosen and ground as directed in making gold-size; then laid by for use, in a covered earthen pan; and occasionally moistened, as the gold-size. The yellow ochre must be of the best quality, and prepared in the same manner.

To make Or-Molu.

In half a pint of clear water, gently boil, for five minutes, two ounces of the best gamboge, powdered fine: strain it through a linen cloth, and put it into a bottle, which should be well corked.

Take one ounce of saffron, half an ounce of turmeric, and one quarter of an ounce of dragon's blood; boil them in one pint of clear water, for fifteen minutes, now and then stirring them up from the bottom of the vessel: strain them also through a linen cloth, and put them into a corked bottle: this is the *repass*.

Put about five or six bits of starch into a clean half-pint earthen pan, with a tea-spoonful of clean water, using the finger to mix them with; then add water, till the pan is three parts full; boil it for one minute, and it will be clear, like clear size; blow off the skin that will arise from the boiling, and put it immediately into another pan: add four drops of the gamboge-liquor, and two drops of the *repass;* stir them round, and the *or-molu* is made, and fit for use. The eyes of foliage, &c. in carved work must be touched with a little of the gamboge-liquor, called high-coloured *or-molu*, unmixed with any thing else.

The *or-molu* in general use, though it is by no means the best, is made by dissolving the gamboge in spirit of wine, instead of water, which will give it the appearance of clear varnish; but when dropped into clear size, to be substituted in this case for starch, it will be yellow: the quantities of the ingredients are alike in both cases.

To Gild Plaster of Paris Casts.

Plaster figures, vases, busts, &c., are gilt, both in burnished gold and oil-gilding, by first coating them with very hot, weak, size: and afterwards, four times over, with hot clear size: if any holes appear,

they must be filled up, evenly, with a putty made of strong size and whiting: the rest of the process is the same as after *smoothing*, in both cases.

To Gild Paper in Burnished Gold.

It must be tacked to a board by each corner, and then be gold-sized and gilt. It must be burnished on a piece of plate-glass, bedded in glazier's putty, or on a clean polished marble slab.

To make Oil Gold-Size.

Put as much linseed-oil into a broad earthen vessel as will cover the bottom an inch deep, and add to it four or five inches in depth of water: let the vessel be exposed to the weather for three or four weeks, occasionally stirring them up, till the oil appears of the consistence of treacle; it must then be separated from the water, be put into a long bottle, or into a separating funnel used by the chemists, and be placed in such a degree of heat, as will render it perfectly fluid; the clear part should then be poured off, and it will be fit for use. Take any quantity of the best, yellow, stone-ochre, and a fourth part of white-lead; mix them with the oil on a flag-stone, using a mullar and pallet-knife: this mixture is oil gold-size; it must be put into an earthen vessel; and be covered with water, to prevent it from skinning.

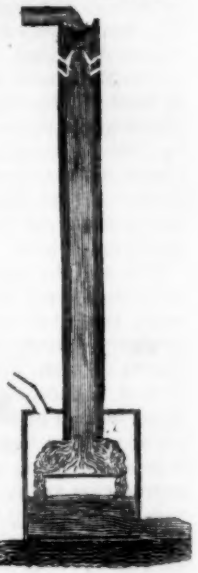
On the Blowing of Air into Furnaces, by a fall of water. *By the late* William Lewis, M. D.

[CONTINUED FROM PAGE 193.]

In Dauphiny, in France.—The blowing machines used in Dauphiny, for the forges and smelting furnaces, have a great resemblance, in their general structure, to the foregoing. They are described by Swedenburg, in the second volume of his *Regnum Subterraneum*, but with little exactness: a more accurate description, and figures of them, taken from the papers left by Reaumur, are inserted in the *Art des Forges et Fourneaux à Fer*, published by the direction of the French Academy.

The upright pipe, in the figure, is generally between twenty-five and twenty-six feet high: it is composed of two pieces of fir, hollowed and joined together by iron work. Instead of a distinct reservoir or funnel on the top, a part of the pipe itself is hollowed, so as to perform the same office: at the top it is twelve inches and a fifth in diameter, (English measure,) from thence it grows narrower, to the depth of nearly thirty-four inches, where its width is only about three inches and three-quarters; immediately below this part, called the choak, its cavity widens to nearly eight inches and a half, and this width it preserves throughout the rest of its length. Under the choak

are ten air-holes, six of which are in one horizontal plane, at equal distances from one another, and the rest are about three inches and three-quarters lower down: all the holes are cylindrical, near two inches in diameter, and cut at such an obliquity, that the orifice of the upper ones is, on the inside of the pipe, eight inches; and on the outside only five inches below the choak.



The tub, or air-vessel, which receives the lower end of the pipe, is five feet and a half, or a little more, in depth, and nearly as much in width: the pipe enters into it about seventeen inches: about the middle of its height, is a flat stone or iron-plate, supported by cross bars of wood. The air passes off, as already mentioned, through a pipe inserted into the upper part of the tub, and the water through a hole at the bottom: on the outside of this hole is fixed a wooden frame, with an upright slider, by which the aperture for letting out the water may be occasionally increased or diminished. The blast is regulated, and the air suffered to escape, when it is not wanted, by a hole in the blowing pipe, to which is fitted a valve or stopper.

One of these machines is said to be sufficient for the forge, or iron finery: and two or three for the furnace in which the iron ore is run down.

In Foix, in France.—In the county of Foix, the blowing machines, as described by Reaumur, in the "*Art des Forges*," above quoted, are considerably different from the foregoing. The pipe is rectangular, and the part above the choak divides into three funnel-shaped partitions. On the top is a reservoir, or cistern of water, and two of the partitions, close on all sides, pass up above the surface of the water, for carrying down air, and thus supplying the place of the lateral air-holes: the water enters into the third partition, which is the only space between the two foregoing, and which has but two sides, formed by the two opposite sides of the others.

The author makes the principal difference of these machines from those of Dauphiny, to consist in this disposition of the upper part; but the plate annexed to his description, shows another, which is, perhaps, more material to the success of the instrument. The whole height of the pipe, including that of the water in the reservoir on the top, is, according to the scale, twenty or twenty-one feet; and the choak, or narrow throat, is almost down to the middle of this height, so that the water issues through the choak with a velocity which it acquires from a pressure of about ten feet, which is greater than in the machine of Dauphiny in the proportion of about eleven to six: the quantity of water seems, also, to be much less, in proportion to the width of the pipe; the great pressure, probably, occasioning it to

spread, so as to fill a larger bore than it could do when falling with less velocity.

Two pipes, divided in the same manner at the top, are fed by one reservoir: the lower ends of the pipes enter into one large oblong box, from which the air and water pass out, as in the foregoing machines described.

At St. Pierre, in Languedoc.—M. Barthes, in a curious paper, printed in the third volume of the "*Correspondence of the French Academy*," gives a minute description, though, in some respects, not so clear as could be wished, of a blowing machine at the forge of St. Pierre, on the river Obriou, which he looks upon as one of the most perfect of the instruments of this kind. Its general structure is nearly the same with that of Foix, but the height of water above the choak much less.

The upright pipe is square, about nine feet high, and somewhat more than seven inches wide. Into its top are inserted, at opposite sides, two pyramidal air-pipes, widening upwards, and passing up obliquely through a basin of water four feet high. The space included between the pipes, at their lower ends, under the basin, is a kind of hopper, into which the water enters through two apertures in the bottom of the basin: to each of these apertures is fitted a piston or stopper, hung to the end of a lever, by which it is raised, more or less, according as more or less water is required. Two of these instruments are furnished with water from one basin; and the lower ends of both enter into one air-vessel, which is nearly five feet high, about six and a half long, near three and a half wide at one end, and not quite two at the other. The stones for the water to fall upon are somewhat less than four inches and a half distant from the pipes: the water runs off through two rectangular apertures at the bottom, each about eight inches and a half wide, and near six inches high: the pipe which carries off the air is an inch and a quarter in diameter at the small end, where it enters the furnace.

The obscure part of the description relates to the hopper, and the apertures by which the water is discharged from it into the perpendicular pipe. The hopper seems to be divided into two rectangular openings, through which the water runs into the two hoppers, each of them about seven inches and a half long, and in width five inches and a half, measured on the level of the bottom of the reservoir, which is reduced to four and a half at the extremities of the air-pipes, where the hopper also terminates.

The author observes, that in this machine the water issuing from the hopper is necessarily reduced into drops. To satisfy himself more fully of this particular, he took a tin vessel, eight inches and a half square, and six and a half high; in the middle of the bottom he cut a rectangular opening, about an inch and a tenth long, and eight inches wide: to the ~~two~~ long sides of the slit he soldered two tin plates, inclined towards one another, and a third across them. These apertures, he says, represent those of the machine, when the stoppers are drawn up; and water put into this vessel, came out always, during the whole time of its running, in streams, which struck

against and crossed each other; and which, after spreading, were reduced into drops.

In this illustration of the machine, however, it seems clear, there must be something which escapes my apprehension. Having cut an aperture of the above dimensions, in the bottom of a vessel, I fitted to each of the larger sides a plate, half the width of the aperture; both of which plates were moveable, and kept at different inclinations by means of a third plate, which passed across the middle of the two. The vessel being filled with water, I could not observe, as indeed was expected, the least crossing of the streams that ran through it: on the contrary, greatest part of the water issued in two opposite directions, horizontally, from between the ends of the plates.

[TO BE CONTINUED.]

Description of the manner of Polishing and Silvering Plates for Looking-Glasses, as practised in Paris.

[CONCLUDED FROM P. 148.]

Fourth operation. After the third operation, the plates are again examined. By holding them up to the light, it is seen whether they have any defects, such as flaws, air bubbles, or cavities. If they have any cavity which may be taken away by fresh grinding, they are again laid upon the table, and ground; but, if the cavity is so deep that it cannot be taken away in that manner, without consuming a great deal of time, and rendering the plate very thin, the plate is cut into various pieces, in the same manner as is done when it has originally any defect of consequence. These pieces, which are always left as large as possible, serve to make looking-glasses of a smaller size: but, in that case, the whole of them sell for much less than they would have sold for if they could have been kept, without defects, in one piece. When the plates have been examined, as before mentioned, they are made perfectly square; the sharpness of their edges is also taken off, by rubbing a piece of glass against them, so as to give them a kind of bevel.

They are then ground afresh, in the manner before described, by rubbing them with plates of glass, fixed in frames furnished with handles; but, instead of sand, emery (a sort of red oxide of iron) is made use of: it must be finer and finer, as the work advances, and no less than four kinds of it (of different fineness) are used. When the plates are perfectly smooth, they are to be rendered brilliant, the manner of doing which I shall now describe.

Fifth operation. The plate is laid upon a woollen cloth; but it is first coloured red on the under surface, that the degree of transparency and brilliancy may be perceived. It is then covered with a powder, which the workmen call *Rouge d'Angleterre*, composed of

the residuum from the distillation of aqua fortis,* mixed with vitriol of iron and common salt. In this mixture, a decomposition takes place: the sulphuric acid of the vitriol of iron combines with the soda of the common salt, and the oxide of iron is separated. By washing the mixture, the muriatic acid of the salt (which has perhaps dissolved a certain portion of the oxide of iron) is taken away, and also the sulphate of soda which is formed. The essential part of the above mixture seems to be the oxide of iron: in fact, emery, which is commonly used for polishing, is an oxide of iron. The residuum of aqua fortis contains oxide of iron, an additional quantity of which is produced from the mixture of vitriol of iron and common salt. But these oxides are in a state of greater division than emery; and the clay, being of a soft nature, also helps to render them less rough; they therefore wear the glass less, and, of course, polish it to a higher degree, than emery. When the plate is covered with the powder above mentioned, the workman has a sort of brush, the bottom of which consists of a kind of felt or velvet, and the top projects on each side, so that the workman can lay hold of it with both his hands. Having covered the brush with the powder, he rubs the glass with it: but, as it is necessary that a continual pressure should be applied, which would be very fatiguing, a kind of spring is made use of, three or four feet long, made of a piece of flexible wood, rendered still more elastic, and less liable to break, by means of cord, or of parchment. At one end of the wooden spring is an iron point, rather blunt, which presses above against a board suspended over the head of the workman, and enters into the board a sufficient depth to prevent its slipping; but not so much as to occasion any difficulty in changing its place. The other end of the spring, (which is covered with skin, that it may be laid upon the glass without danger, when the brush is taken off,) fits into the handle of the brush, but is not fixed to it, as it is necessary that the brush should be easily taken off, when a fresh quantity of the composition is to be applied upon it. By means of the above contrivance, the workman has nothing to do but to push the brush backwards and forwards, without being obliged to press upon it. It must, however, be evident, that there is a point upon which the spring (being there most bent) presses with most force, in consequence of which, the plate would, at that part, be worn hollow. To avoid this, the workman places the spring in such a position that its greatest pressure is upon the middle of the plate: he then begins to make use of his brush, passing it most frequently over those parts on which the spring presses with least force; by which means, every part is equally polished. In order that the brush

* The distillers of aqua fortis make use of a clay which contains a great deal of pyrites, or vitriol of iron: with this they mix nitre, and proceed to distillation. A part of the nitric acid is decomposed, which gives its oxygen to the sulphur of the pyrites, and thereby causes it to pass into the state of sulphuric acid. This acid combines with the potash, (another constituent principle of the nitre,) and the nitric acid, expanded by the heat, rises in distillation. The residuum then consists of (first) sulphate of potash, (secondly) oxide of iron, produced by the decomposition of the pyrites, and (thirdly) clay. By washing this residuum, the sulphate of potash is taken away.

may leave no traces of its course upon the plate, the workman takes care to move it in all directions. When the glass is thought to be sufficiently polished, it is placed upon a carpet of a dark green colour, which shows whether all the parts have the same degree of brilliancy. Those parts which have not been sufficiently polished appear whiter; they are marked, and the workman goes over them again.

It has been proposed to make use of machines for polishing plates of glass. This would indeed save a great deal of hand-labour, but a machine acts uniformly, and, as it were, blindly; whereas, a workman sees those parts of the plate which stand most in need of his labour and attention. Sometimes, in consequence of the roughness of the plate in certain parts, such a degree of friction is produced as makes it necessary to proceed more gently with the work. A machine acts always with the same degree of force, from which there would arise great danger of the plates being broken. It would therefore be hardly possible to make use of machines for the first or second operation; but I think they might be advantageously employed for the third and fourth. Such machines have already been described and executed.

Manner of Silvering the Plates.

This operation is performed upon a large table of stone, or of very thick wood, perfectly smooth and flat, and covered with gray paper, thoroughly stretched: the table is moveable on an axis, in order that it may be inclined, so as to cause the mercury to run into a groove made round the table. On this table is spread a sheet of tin-foil, well cleaned, and which has been hammered after being laminated. The workmen think it is necessary the tin-foil should be hammered, probably because, by being hammered in all directions, its texture is made more equal than it is left by the rollers, which, by stretching it more one way than the other, are apt to render it fibrous. A small quantity of mercury is poured upon the sheet, and spread all over its surface, so as just to moisten it. A larger quantity is then poured on, enough to cover the sheet to a certain thickness; which thickness is always the same, and amounts to some lines. This requires some explanation.

There are certain substances to which mercury has more affinity than to others. When this affinity is much less than that of its particles to each other, it adheres a little to these substances, but does not spread over them, or sink into them. Of these substances, it is said, that they are not *moistened* by the mercury. (What is here said of mercury may be applied to any other liquid substance.) If a small quantity of mercury is poured upon a substance of this nature, which has a surface perfectly flat and horizontal, it evidently preserves a spherical form, provided the globule is so small that its weight is not sufficient to overcome the force which keeps all its particles arranged in the form of a sphere, round a common centre. If more mercury is added, until a depression is perceived upon the surface of the globule, and the height or vertical diameter of this

flattened sphere is measured, it will be found that, whatever quantity of mercury is afterwards added, the height or diameter of the globule cannot be increased; but the mercury will spread itself horizontally, and always in a circular form, until the circumference of the circle extends to the edge of the surface upon which it lies: it will then run off, supposing it to have no affinity, or very little, with the substance upon which it is poured; that is, if it is poured upon the middle of a square surface, it will not extend itself into the angles thereof, but will run off as soon as it has reached the sides. But if, on the contrary, a small quantity of mercury is poured upon the substance with which it has sufficient affinity to become moistened by it, the following circumstances take place. First, it will be seen that the globule is less thick, because its affinity with the substance (being equal to a force pressing on it) produces a depression at the top of the globule. Secondly, it will cover the whole surface of the substance; because, supposing, as before, the surface of the substance to be square, it will not (when it has arrived at the edges of the square) tend to spread any farther, except by its weight; whereas, towards the corners, it will tend to spread farther, both by its weight and by its affinity with the substance. Thirdly, when it has covered the whole surface, it will not immediately run over, because it will still be a little retained by its attraction for the substance, so that a small quantity of mercury may yet be added, without causing it to run over; a circumstance which gives a little latitude to the workman. Hitherto, the mercury remains of the same height upon the tin-foil, which height can only be increased, in a small degree, towards the end, and varies according to the degree of its affinity with the substance on which it is poured. It is evident that it must depend, first, upon the adherence of the particles of the fluid with each other. Secondly, on the specific gravity of this fluid. Thirdly, on its adherence to the substance on which it is put. The height above mentioned may be taken by observation: the specific gravity of the fluid is also known; and tables have been given, by different philosophers, of the adherence of mercury, and that of other fluids, to various substances. If their formulæ are exact, it is clear that nothing remains unknown, except the adherence of the particles of the fluid to each other, which may be found by means of the data above mentioned. Or, if the adherence of the particles of the fluid to each other were known, that of the fluid to different substances would be obtained.

When the sheet of tin-foil is covered with mercury, the application of the plate of glass to it must not be too long delayed, because, in that case, the mercury would dissolve the tin-foil. As the surface of the mercury always becomes a little calcined, or may have acquired a little dust, or other foreign substance, a small quantity of water is poured upon it; and, when the plate is about to be laid on, a brush, and afterwards a hare's foot, is passed over it, which entirely removes the calcined pellicle, &c. A band of parchment, extending some lines above the surface of the mercury, is put upon the edge of the table; and the plate, being first made very clean and

dry, is slipped over the parchment. It is necessary that the plate should sink a little into the mercury, that the air may not get between it and the metal; but great care must be taken that it does not sink too deep, because, if it should touch the sheet of tin-foil, it would tear it. The management of this part of the process is more easy than might be supposed; for the glass plate, being of less specific gravity than the mercury, would float upon it, consequently, to make the plate sink a little into the mercury, nothing more is necessary than to press upon it. When the plate is properly placed upon the tin-foil, (which ought to extend on every side a few lines beyond the plate,) the table must be gently inclined: a great part of the mercury then runs off, and the plate comes in contact with that part which adheres to the tin-foil. A short time after, the plate is covered with a woollen cloth, and several weights are laid on it, to increase its adherence to the tin-foil. When it has been in this situation a sufficient time, the projecting edges of the tin-foil are cut off, and the plate is taken up.

Mercury has some adherence to glass; and, if it does not moisten it, it is because the adherence of its particles to each other is greater than that of those particles to glass. But, in the present case, the mercury, being fixed by the tin, no longer tends to run into globules, but adheres to the glass, particularly when there is no air between them. By its means, the tin-foil adheres strongly to the glass; in the same manner as, by the help of water, the laminæ of crystals (those of sulphate of lime, for instance,) adhere to each other. The mercury alone here acts as a mirror. If it is taken from the glass, it generally appears to be covered with a white pellicle; and, when looked into, reflects objects more perfectly than the best looking-glass. The glass, therefore, only serves to prevent the mercury from being calcined, and causes its surface to be always perfectly even. As it is necessary that the rays of light should pass through the glass, to be reflected by the mercury, and that they should pass it a second time, to come to the eye, it must be evident that the glass ought to be perfectly even, transparent, and colourless. The tin serves only to lay hold of the mercury, and to fix it against the glass; for, by laying a plate of glass upon mercury, or by inclosing a small quantity of that fluid between two plates, a looking-glass might be made, which would act exactly like the others, but would be more heavy, and less convenient for moving from place to place.

Of Clock and Watch making, and of the method of Dividing the Day at different periods of time.

[Continued from p. 154.]

The invention of Clocks moved by wheels and weights, and their progressive improvement till the middle of the seventeenth century.

The inventor of clocks moved by wheels and weights, as well as the period of the invention, is totally unknown. The researches of learned men on this subject, however, refute the opinion of those

who make the invention to be not older than the 14th century. The invention, however, was not very great, as the more perfect water-clocks were, before that period, furnished with wheels, so that the only improvement was the substitution of a solid body to act as a moving weight, instead of water. The principal point was to produce uniformity in the action of these weights; and in this respect the first clocks moved by weights were deficient till the time of Huyghens. It is not, therefore, to be wondered at, that the application of weights to clocks as a moving power, should excite so little attention as to be scarcely thought worth notice by cotemporary writers: water and sand were indeed more convenient than a solid weight, which requires too much room for its motion. The author is of opinion that the origin of clocks with weights is as old as the 11th century, and adduces very probable grounds in support of it; but it is not properly ascertained, whether the inventor was an European or a Saracen. The oldest complete clock moved by weights, of which there is any certain testimony, is that sent by the sultan of Egypt, in the year 1232, to the emperor Frederic II., the value of which was at that time estimated at 5000 ducats. In the 13th century many of the church steeples in Italy, were furnished with clocks, which were moved by weights, and which struck the hours. About the same time, the well known clock-house at Westminster-hall was furnished with a clock that struck the hours; the expense of which was defrayed by a fine imposed on one of the judges. The clock moved by weights of the abbot Richard of Wallingford, which by many has been considered as the oldest, was constructed in the 14th century. In the year 1394, Padua obtained the first clock, supposed to have been constructed by the celebrated philosopher, physician, astronomer, and mechanist, James Dondi. That such clocks might be introduced into England, Richard III. gave a patent to three Netherlanders, in the year 1368. Courtrai in France had a clock that struck the hours, so early as the year 1332: it was carried away in that year by Philip the Bold of Burgundy, and conveyed to Dijon, where it is still to be seen. The first large clock at Paris, was erected in 1364, by a German artist, Henry von Wick, who received daily, six French sous, together with free lodging in the tower of the Palais, to which the clock was removed in 1370. Bologna obtained the first public clock in 1356; Pavia, in 1402; Breslaw, by Schwelbelin, in 1368; Strasburg, in 1370; Augsburg, in 1398; Nuremberg, in 1462; and Venice in 1497. The first clocks were expensive, and many cities, desirous of having such machines, were not able to raise money to purchase them. In the year 1523, the fines levied from the students at Oxford, were employed to defray the expense of the clock erected on the church of St. Mary. Private individuals, however, about this time, began to obtain clocks. The first instance of a clock with weights, being employed for astronomical purposes, occurs in 1484, when Walther, as he says, with a well regulated clock, made an observation on Mercury. Tycho had three of these clocks, which showed minutes and seconds: he found, however, that they were exposed to variations, from the influence of the atmosphere and

wind; on which account, he caused to be constructed a quicksilver clock, in which distilled quicksilver, instead of sand and water, showed minutes and seconds. To produce a uniform fall, so much quicksilver dropped from another vessel into the hour-vessel, as was sufficient to keep it always at the same height. As the study of astronomy required more accurate measurers of time, we are indebted to that science for the improvement of these instruments, the construction of which does so much honour to the human genius.

Invention of Watches and Table Clocks.

Hele, of Nurnberg, is generally considered as the inventor of watches, or spring-clocks, as they ought properly to be called; the first of which he is said to have constructed in the year 1500. According to others, Halbrecht of Strasburg was the inventor: but his first clock was constructed in 1520, and consequently twenty years later than Hele; who, it is certain, made small spring-clocks or watches so early as 1500. Nurnberg and Augsburg were the first cities of Germany, in which watches were made. Hele's watches not only indicated the hours, but struck them also. Andrew Heinlein, who trod in Hele's footsteps, made small clocks in the smelling-balls which were used in his time. In the architectural office at Augsburg, there is a watch, above 200 years old, which strikes the hours: it is contained in a crystal case, and was made by Buschman. There were striking watches in France, in the time of Louis XI. The oldest watch in England, that goes still pretty well, is of the year 1540, and is preserved in the palace of Hampton Court.

Invention of the Fusee, Pendulum, and Spiral Spring.

The fusee was, in all probability, invented in England, about the end of the 16th century, by whom, it is not known, and was thence introduced into Germany. It was examined geometrically by Varignon and De la Hire, in order to determine the most advantageous form; which, however, does not always avail, on account of the inequality of the spring, and, therefore, advantage is taken of other mechanical means: of this kind is the balance, by means of which the power of the spring can be adjusted, and which undoubtedly was invented in Swisserland about the beginning of the 18th century. In the first watches with fusees, the diameter was small, and the box large and broad. The catgut, by which it was wound up, passed eight or nine times around the fusee. This made the watch clumsy and ill-shaped. The catgut, however, was soon exchanged for a chain, which consists of small plates of steel, united together with great labour. In the middle of the 17th century, Huyghens invented a better method of regulating the movement of clocks. In the year 1657, he applied the pendulum as a regulator to large clocks moved by weights; and, some years after, recommended the balance spring for watches. Before that period, some had used, instead of the spoon-formed balance, one in the form of a ring, or employed a small fly wheel; and Hautefeuille used at first a swine's bristle, and then a weak, straight, steel spring, for regulating the balance. In the year

1674, Huyghens caused a watch with a spiral balance spring to be constructed by Turet at Paris. Dr. Hook entered into a dispute with Huyghens in regard to this invention, and proved that he had invented such a watch for Charles II., which had the inscription *Robert Hook invenit* 1658, *Tompion fecit* 1675; and that he had solicited a patent for such watches in 1660, but did not obtain it till 1675.

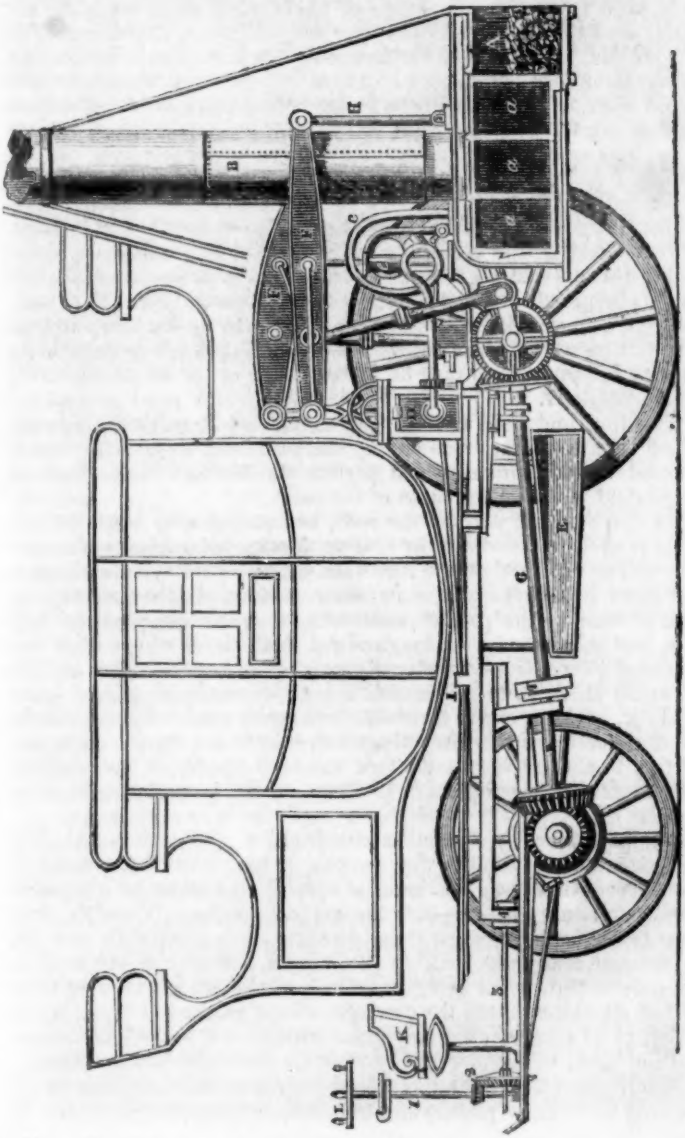
ENGLISH PATENTS.

Account of the Locomotive Steam Coaches invented by MESSRS. BURSTALL *and* HILL, *described under two Patents.* Enrolled, August, 1825, and June, 1827.

THE *first* effort of Messrs. Burstall and Hill, to attain that important desideratum, of rendering steam power available for propelling carriages on ordinary roads, was the subject of a patent enrolled nearly two years ago. The description of their original plan is, however, necessary, as the inventors have, in their late patent, retained the greater part of the arrangements contained in the former,—these are as follow:

A, represents the boiler, which is formed of a stout cast-iron or other suitable metal flue, inclosed in a wrought-iron or copper case, as seen in section, where A is the place for fuel, and *a a a* are parts of the flue, as seen in section; the top being formed into a number of shallow trays, or receptacles for containing a small quantity of water in a state of being converted into steam, which is admitted from the reservoir by a small pipe. B is the chimney, arising from the centre flue; at D are the two cylinders, one behind the other, which are fitted up with pistons and valves, or cocks, in the usual way, for the alternate action of steam above and below the pistons. The boiler being suspended on springs, the steam is conveyed from it to the engines through the helical pipe, *c*, which has that form given to it to allow the vibration of the boiler without injury to the steam joints. E is the cistern, containing water for one stage, say 50 to 80 gallons, and is made of strong copper, and air-tight, to sustain a pressure of about 60 pounds to the square inch. At *e* is one or more air pumps, which are worked by the beams, F F, of the engines, and are used to force air into the water vessel, that its pressure may drive out, by a convenient pipe, the water into the boiler, at such times, and in such quantities as may be wanted. The two beams are connected at one end with the piston-rods, and at the other with the rocking standards, H H. At about one-fourth of the length of the beams from the piston-rods, are the two connecting rods, *g g*, their lower ends being attached to two cranks, formed at angles of 90° from each other on the hind axle, giving by the action of the steam, a continued rotatory motion to the wheels, without the necessity of a fly wheel. The four coach-wheels are attached to the axles, nearly as in common coaches, except that there is a ratchet-wheel formed upon the back part of the nave, with a box wedged into the

axle, containing a dog, or pall, with a spring on the back of it, for the purpose of causing the wheels to be impelled when the axle revolves, and at the same time allowing the outer wheel, when the



carriage describes a curve, to travel faster than the inner one, and still be ready to receive the impulse of the engine as soon as it comes to a straight course.

The patentees have another method of performing the same operation, with the further advantage of backing the coach when the engines are backed. In this plan the naves are cast with a recess in the middle, in which is a double bevel clutch, the inside of the nave being formed to correspond. These clutches are simultaneously acted upon by connecting levers and springs, and which, according as they are forced to the right or left, will enable the carriage to be moved forward or backward. To the fore naves are fixed two cylindrical metal rings, round which are two friction bands, to be tightened by a lever, acted upon by the foot of the conductor, and which will readily retard or stop the coach, when descending hills. K is the seat of the conductor, with the steering wheel, L, in the front, which is fast on the small upright shaft, 1, and turns the two bevel pinions, 2, and the shaft, 3, with its small pinion, 4, which, working into a rack on the segment of a circle on the fore carriage, give full power to place the two axles at any angle necessary for causing the carriage to turn on the road, the centre of motion being the perch-pin, I.

The fore and hind carriage are connected together by a perch, which is bolted fast at one end by the fork, and at the other end is secured by two collars, which permit the fore and hind wheels to adapt themselves to the curve of the road.

To ascend steep parts of the road, and particularly when the carriage is used on rail-ways, or to drag another behind it, greater friction will be required on the road than the two hind wheels will give, and there is, therefore, a contrivance to turn all the four wheels. This is done by the pair of mitre-wheels, 4, one being on the hind axle, and the other on the longitudinal shaft, 6, on which shaft is a universal joint, directly under the perch-pin, I, at 7. This enables the small shaft, 7, to be turned, though the carriage should be on the lock. On one end of the shaft, 7, is one of a pair of bevel wheels, the other being on the fore axle, which wheels are in the same proportion to one another as the fore and hind wheels of the carriage; this causes their peripheries to move on the ground at the same speed.

The patentees, by a peculiar construction of a boiler, intend to make it a store of caloric; they propose to heat it from 250 to 600 or 800 degrees of Fahrenheit: and by keeping the water in a separate vessel, and only applying it to the boiler when steam is wanted, they hope to accomplish that great desideratum in the application of steam to common roads, the making just such a quantity of steam as is wanted; so that, when going down hill, where the gravitating force will be enough to impel the carriage, all the steam and heat may be saved, to be accumulating and given out again at the first hill or bad piece of road, when, more being wanted, more will be expended.

The engines are what are called high-pressure, and capable of working to 10 horse power; and the steam is purposed to be let off

into an intermediate vessel, that the sound emitted may be regulated by one or more cocks.

From the foregoing description we think we are warranted in saying that there is a considerable degree of ingenuity, as well as originality, in many of the details, and also in the general arrangement of the machinery. In this light, we regard their mode of allowing the several wheels to move simultaneously at different velocities, the convoluted form given to the steam and water pipes, (by which very simple means, the injurious effects of jolting are avoided,) and the mode of injecting water into the boiler, by means of compressed air.

By the *recent* improvements, the boiler is to be placed upon an additional pair of wheels, so that the whole machine may run upon six wheels instead of four. The patentees claim two distinct modes of employing this extra pair of wheels, either of which may be adopted. By the first mode, the back end of the boiler is bolted to the axle-tree of the extra wheels, and the front end rests and turns upon a pivot, fixed to the axle of the middle pair of wheels. By the second mode, the axle of the hind wheels turns upon a centre, and the boiler is attached to a frame, which encompasses it: this frame is suspended upon springs, or not, (according to the nature of the road,) the fore part of it being bolted to the axle of the middle pair of wheels; by either of these contrivances, the boiler and its carriage may be made to adapt itself to bends in the road, without incurring injurious strains.

The next improvement of material importance, consists in the construction of the steam pipes, which have sliding and moveable knee-formed joints, to admit of their extension or contraction, when the carriage is passing over rough, or undulating ground; thus constructed, the pipes also accommodate themselves to bends and irregularities in the road.

The third improvement relates to the mode of steering the carriage, which is effected by a chain circumscribing the steering wheel, the ends of the chain then passing round pulleys fixed on the carriage frame, are attached to the opposite extremities of the fore axle-tree.

Preparations are nearly completed for exhibiting this carriage, and its operation, in a piece of ground, engaged for that purpose.

[*Register of Arts.*

Description of the Patent Char-volant, or Carriage, to be drawn by Kites. Invented by Colonel James Viney, *of the Isle of Wight, and* George Pocock, Esq. *of Bristol.*—Enrolled, Oct. 1826.

In our number for February, we published some remarks upon the project of the patentees of the invention under notice, and now add a description of the kind of kite, and car, which they employ.

The patentees propose to attach to the car, or vessel, to be moved,

the cords of one or more kites, according to the force of the wind, and the resistance to be overcome. The kite, *a*, fig. 1, is jointed in the middle, that it may be folded up, and carried, or stowed away with greater facility, and that it may be adjusted so as to present to the wind a surface of any required dimensions: this is effected by the four cords, *b b b b*, which are brought together by passing through the dead eye, *c*, whence they proceed to the car, and are arranged to the required lengths by the persons therein. The cords are also used for regulating the direction of the power, by shortening those on the right hand when the car is required to be turned to the right, and those on the left hand, when it is required to be turned to the left. But the char-volant, represented by fig. 2, is principally guided by the T handle, *e*, and stem, *e f*, which act on the axis of the fore wheels by means of an endless band, or cord, passing about the pulley, *f*, fixed on the lower end of the stem, *e f*, and the pulley, *g*, fixed on the bed of the axletree of the fore wheels. The machine is stopped, or its motion retarded, by the drag, *k*, which is attached to the perch, by a spring, to keep it off the ground, till the motion is required to be retarded, or the car stopped, when its fluke end is pressed into the earth by the lever, *h*, acting on the connecting piece, *i*.

Fig. 1

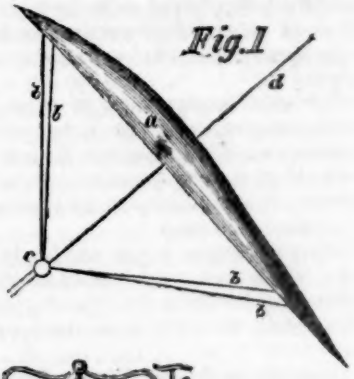


Fig. 2

When great power is required, two or more kites are placed in succession one behind the other, and so attached together by cords, that whatever motion or direction is given to one, will be communicated to the others.

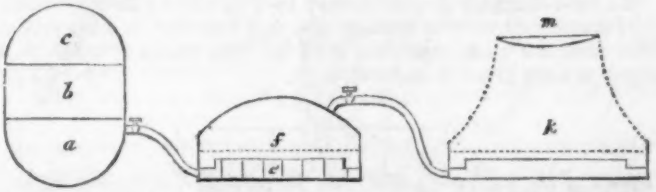
The patentees propose to attach, occasionally, to their car a platform on small wheels, for the purpose of carrying a poney, to be employed in dragging the machine, in cases where the kites cannot be applied.

The views of the patentees are not confined to the application of the power of kites to the moving of carriages upon land, but likewise to the sailing of ships, raising weights, and other purposes; but they do not describe in their specification their method of applying kites to raise weights.

We are aware that kites have been employed to assist in swimming, by Dr. Franklin, who considered that with such an aid a man might swim across the channel from Dover to Calais, and that attempts have been made to move both boats and cars by the same means. [*Ib.*

Account of the Patent Salt Pans, invented by WILLIAM JOHNSON, *of Droitwich.*—Enrolled June, 1827.

MR. JOHNSON employs steam of different degrees of heat, to produce the evaporation in pans entirely enclosed from the atmosphere, so that the vapour arising from the first pan, where the *fine salt* is produced, is employed in heating the second, where the *broad salt* is formed; and the vapour arising from the latter is employed, in like manner, to produce, in the third pan, *British bay salt.*



A sketch of the steam boiler is represented in the annexed drawing, divided into three portions, *a*, *b*, and *c*; and steam is generated in one or more of these divisions, according to the supply required. When the steam in *a* is raised to a pressure of twenty-five pounds on the square inch, that in *b* will be twelve, and that in *c* five pounds.

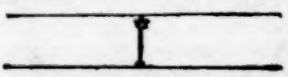
When only one of the divisions, *a*, of a steam-boiler, about seventeen feet by ten, is employed, it will heat pans to the extent of 2400 square feet up to 164° Fah. And when the three divisions, *a*, *b*, and *c*, are used together, an extent of 4300 square feet will be heated to the same temperature.

The steam is conveyed in a pipe from the boiler to a steam vessel

e, under the fine salt pan *f*. This pan is made steam-tight, and the steam arising therein is conveyed by a pipe to a similar vessel under the broad salt pan *k*. Over the broad salt pan *k*, is placed the bay salt pan *m*, and the space between them is enclosed by thin boards, or other light material, to confine the vapour arising from *k*, in order to produce the required heat in the pan *m*. This pan is made lowest in the middle, as represented in the drawing, so that water condensed on its lower surface may be collected in one place, where it is received and carried off in a spout, to prevent its return into the brine in the lower pan *k*.

The patentee considers it of great importance to keep the bottom of the pans clear of salt, and for that purpose employs rakes, which are kept constantly in motion, by a steam engine. These rakes deposit the salt in receptacles at the sides of the pans. The rods by which the rakes are moved, pass through stuffing-boxes in the pans, to prevent the escape of steam. When there are many rakes in a row to put in motion, it is effected by a horizontal shaft from the steam engine, which by means of bevel gearing puts in motion a series of nuts, screwed upon the rake rods, by which the various rakes are made alternately to advance and recede.

For the purpose of making the interior surface of the pans smooth, to facilitate the removal of the salt, the pieces of which it is composed are united by turning down the edges at right angles, and rivetting them together, as represented by the annexed sketch. The steam vessels under the pans are strengthened by a number of link bolts, attached to the joinings underneath the pans by a forked end, taking in the bent joinings; and to the bottom of the steam vessel, by being hooked to staples, as represented.



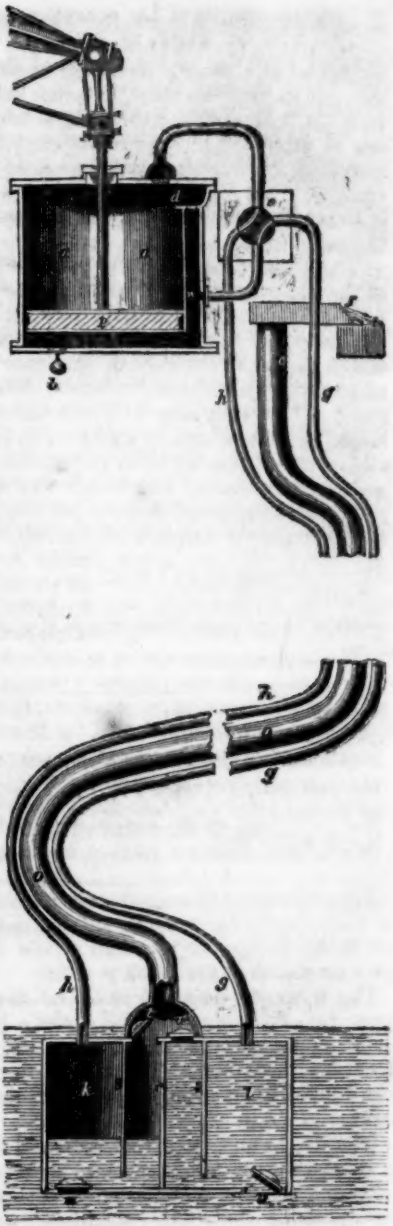
We have deemed it unnecessary to enter into a farther detail of Mr. Johnson's process of making salt, as it does not, in other respects, differ from the plan heretofore used by him, and for which he obtained patents in 1823 and 1824. [*Ib.*

Account of the Hydraulic Machine, for raising Water from Mines, or communicating Motion at a distance from the first mover. Patented by CHARLES SEIDLER, Esq.—Enrolled June, 1827.

THE patentee proposes to raise water from any depth, and through any straight or circuitous passage, by means of air communicated in pipes from the place where the pumps can be most conveniently worked to the reservoir, or place, from which the water is to be raised, in the manner represented in the accompanying figure: where *a a* represents a cylinder, in which a piston, *p*, works by means of a steam engine, or other power. *h g* are copper pipes, forming a com-

munication between the cylinder, *a a*, and the cast-iron tank, or vessel, *k l*; *o o* is a large delivery pipe, of copper or other material, through which the water is conveyed from the tank and discharged; at *r* is an air-tight partition, dividing the tank into the two parts, *k* and *l*; and *s s* are two air-tight partitions, proceeding from the top nearly to the bottom of the tank: *e* is a two-way cock for effecting an alternate communication between *a* and *k*, and between *a* and *l*.

The other parts of the machine will be explained in the following description of its action. Suppose the piston, *p*, to be raised from its present position in the cylinder, the air above it will be conveyed through the valve *c*, and the pipe, *h*, into the vessel, *k*, and force the water contained therein through the valve, *t*, up the pipe, *o o*, while air will be supplied to the cylinder below the piston through the valve, *b*. When the piston descends, the air will pass from the lower to the upper side of it, by the valve, *d*; this operation is to be continued till all the water is forced out of *k*, when the two-way cock, *e*, must be turned, to change the communication through the valve, *c*, to the pipe, *g*, and the part of the tank, *l*: at the same time, the air which was forced into *k* will be permitted to re-enter the cylinder through the pipe, *w*, (as shown by the dotted lines in the cock,) *e*, so that no air will be required to enter at the valve, *b*, except at



the commencement of the operation, or when any of the air is discharged with the water, or otherwise dissipated. When the air is liberated from the receptacle, *k*, of the tank, it will be again filled with water through the valve, *m*; the valve, *i*, being shut by the pressure of the water in the pipe, *o o*. During this time the water in *l* will be forced through the valve, *u*; and in the same manner from *k*, through the valve *i*. The cock *e* is to be turned by the hand, or by the machinery, after such a number of strokes, of the piston in the cylinder, as is sufficient to displace the water in one division of the tank.

Mr. Seidler also proposes to put machinery in motion at any distance from the first mover, by raising a piston in a cylinder with air forced under it, which is permitted to descend by its own gravity, when the air is liberated, thus producing an alternating motion to be applied to any required purpose.

The patentee does not claim any thing new in the manner of working the pistons, valves, or cocks, but merely in his method of applying a column of air to produce the effects described.

There are many instances connected with mining and excavations of the earth, where water has to be pumped from depths considerably exceeding that to which atmospheric pressure will raise it, and where the localities of the place prevent the possibility of extending a piston rod from the place where the power can be applied to the water to be raised; and to all such cases this method appears to be applicable; for the pipes may be extended indefinitely, and in any direction to the place from which it may be necessary to remove the water. [*Ib.*

Account of the patent obtained by MARK LARIVIERE, *Machinist, for his Invention of a certain Apparatus, or Machinery, to be applied to the well known Stamp Fly-Press, or other Presses, for the purpose of Perforating Metal Plates, and for the application of such Perforated Metal Plates to various useful purposes.*

THIS invention is an apparatus to be applied to a fly-press, used for stamping holes in metal, and consists of a series of punches, which are to be brought into action at one time, instead of piercing the holes singly, as is the usual practice.

The fly-press intended to be employed in conjunction with this apparatus, does not materially differ from the ordinary press used for stamping holes in plates, or sheets, of metal, except in the construction of the piercer and matrix, the former of which is made with any desired number of punches. and the latter with a corresponding number of holes.

In order to form a correct notion of this invention, it is necessary to state, that the patentee's object is to stamp a multitude of small holes in a metallic plate, at equal distances apart, with extreme accuracy, and considerable expedition; which plates, when so pierced,

are to be employed for sieves, and such other purposes as wire-gauze has been heretofore applied to.

When the holes are to be pierced in the sheet or plate of metal, in straight lines, a series of small punches are fixed in the lower part of the plunger of the fly-press, the bed or matrix fixed below, being perforated with corresponding holes, fitting very accurately to the punches; the sheet or plate of metal is then fastened by cramps to a sliding frame, which conducts it along under the punches. The fly of the press being now turned round horizontally as usual, the punches are brought down and forced through the plate or sheet of metal, producing the first row of holes; the pieces of metal falling down below: and the punches being raised again out of the holes, a winch connected to a worm-shaft, is turned round, which drives the sliding carriage forward, and advances the plate or sheet of metal sufficiently far to bring the plate into a situation for piercing the next row of holes, and so on, until the whole of the plate or sheet of metal is pierced full of rows of holes, at equal distances apart.

If the plates are to be perforated with circular ranges of holes, then a piercer with a suitable number of punches set in concentric circles is to be employed, and a matrix with corresponding holes fixed under it. In some cases, when a circular plate of considerable diameter is to be perforated, it will not be desirable to punch all the holes at once, but to employ a piercer and matrix, in which the punches and holes are ranged in the form of a quadrant, or sextant, or octant, or any other equally divided portion of a circle, and then after every operation, to turn the plate round by machinery, so that the piercers shall fall exactly along-side of the outer ranges of the preceding sector, and thus, by a succession of four, six, eight, or any other number of operations, the area of the complete circle shall be equally and entirely perforated.

It must be obvious, that for every differed arrangement of holes, different punches and matrixes must be employed, and thus plates or sheets of metal may be pierced with holes of any size and closeness, from that of an ordinary colander, to the fineness of gauze.

The patentee claims as a second feature of his invention, the application of the perforated metal plates, or sheets, to the making of sieves, lanterns, and all other kinds of utensils for which wire gauze has been heretofore employed.—Enrolled May, 1826.

[*Newton's Journal.*

Account of the Patent obtained by EZEKIEL EDMONDS, *Clothier, for his Invention of certain improvements on Machines for Scribbling and Carding Sheep's Wool, Cotton, or any fibrous articles requiring such process.*

THE improvements which constitute the subject of this patent, are simply variations in the arrangement of the card rollers belonging to

a carding engine, of the construction commonly employed for straightening the fibres of wool and cotton.

The patentee has arranged these improvements under four heads. First, a mode of reducing the speed of the working rollers, at the back of the large cylinder. Secondly, an additional roller, which conducts the bands that lead from the preparing rollers to the working rollers, in order to increase the velocity of the former, and diminish that of the latter. Thirdly, a roller near the doffer, which catches any of the material that falls, and gives it again to the large cylinder. And, fourthly, a new arrangement of the working rollers, and the introduction of a small roller between every two of them, for the purpose of changing the direction of the fibres.

The small cylinder and its rollers, called the breaker, which receives the material in the first instance, from the feeding cloth, is made to revolve with great speed, for the purpose of breaking up, and preparing the material. The fibres are then received on to the periphery of the large cylinder, and as that revolves, are communicated to the first of the working rollers, on the back of the large cylinder; which rollers being actuated by a band from a small roller below, do not move so fast as in ordinary carding engines. The first working roller, as it goes round, gives the material, just received, to the intermediate roller, which delivers it to the second working roller, and that to the large cylinder again; the large cylinder then communicates it to the third working roller, and through its intermediate roller to the fourth, and again to the large cylinder, and so on, thus changing the direction in which the fibre is carded, and interrupting the speed of the operation; and any loose materials which may happen to have escaped from the cards, and be carried round by the large cylinder, is received by a roller near the doffer, and given to the large cylinder, to be operated upon.

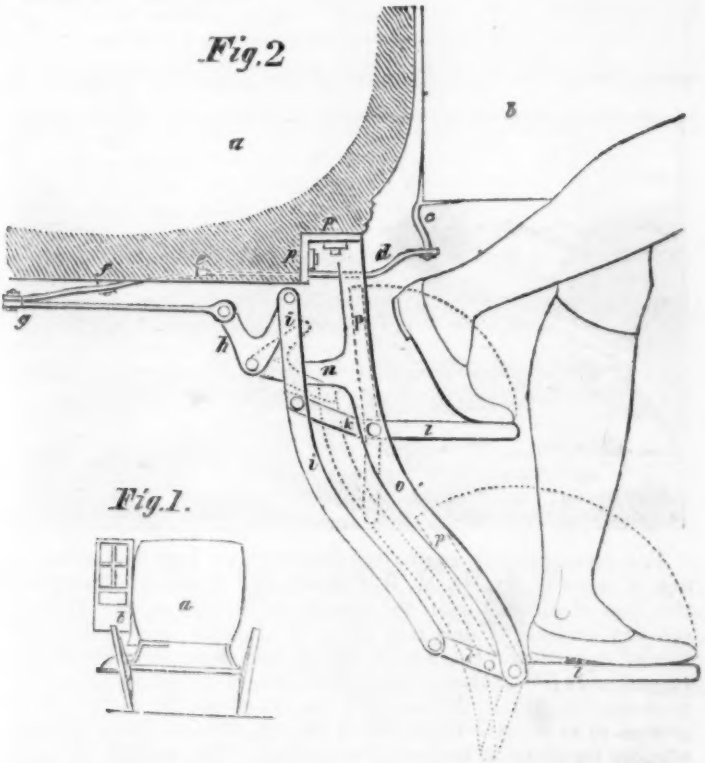
Thus, it will be perceived, the improvement is founded merely upon a supposed advantage which may result from turning over the fibres of the wool or cotton in a different way to other carding engines, and in varying the speed of the several revolving rollers, in a different way to other carding engines, and not in any variation of the principles of a carding engine, or indeed, in its general construction.—Enrolled May, 1826. [*Ib.*

Account of the Carriage Step, patented by ROSS CORBET, *of Glasgow.* Enrolled December, 1825.

THIS improvement is applicable to coaches generally, but is peculiarly adapted to those, of which, the proprietors do not employ a footman to open and shut the door and steps; as the act of opening the door causes the steps to be opened out, and that of shutting the door, shuts the steps up again. For this reason, it is presumed, that the invention will be found a great convenience to medical men, and stage coach proprietors. These steps are strong, without being clumsy;

and their operation, apparently, so smooth and easy, as to require no more force to open and shut the door, than is applied to open and shut a carriage door without this appendage.

In the annexed engraving, Fig. 1 is intended to represent the back view of a coach, on one side of which, the steps and door are both open, and on the other they are both shut. Fig. 2 gives a side view of the steps only, on a larger scale, and will enable the reader to understand their construction.



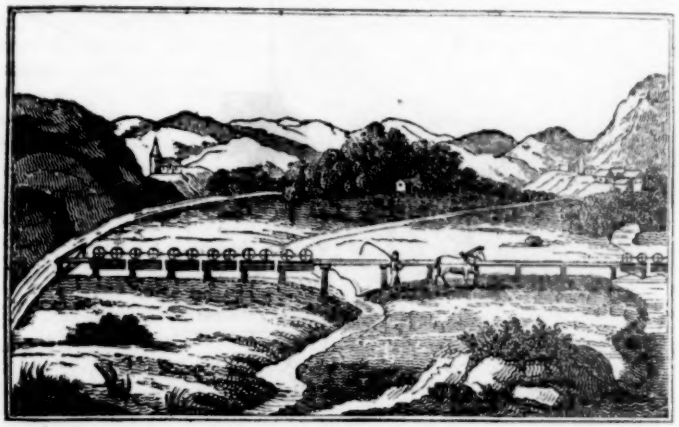
At *a* is the coach body; *b* a part of the coach door open; *c* is a bent iron fixed to the bottom of the door, connected to a curved rod, *d*, at the extremity of which is a joint, *e*, attaching it to the lever, *f*, which moves upon a fulcrum in the middle. At *g*, is another joint, by which, and an intermediate rod, it is attached to one of the horns of the crank, *h*: the other horn of this crank is connected by a joint to the long curved lever, *i i*, which gives motion to the short levers, *k k*, and these last being in one piece with the steps, *l l*, they move together. The long curved bar, *o*, (of which there are two, one on each

side of the steps,) and its short branch, *n*, are fixtures; being bolted to the body of the carriage at *p p*.

A little attention to the train, and connexion, of the levers just mentioned, will show that the act of shutting the door of the carriage will cause the lever, *f*, so to change its direction, as that the crank, *h*, and consequently the bar, *i i*, will be thrown into the position shown by dotted lines; and that it necessarily follows, the steps will be forced into the situation shown by dotted lines, at *l l*.

[*Register of Arts.*

Description of Mr. H. R. PALMER'S *Patent Improved Iron Rail-way.*



THE accompanying engravings represent an improved construction of rail-way, by Mr. H. R. Palmer, civil engineer. Instead of *two* lines of rail laid upon the ground, as heretofore, Mr. Palmer's rail-way consists of only *one*, which is elevated upon pillars, and carried in a straight line across the country, however undulating or rugged, over hills, valleys, brooks, and rivers; the pillars being longer or shorter, to suit the height of the rail above the surface of the ground, so as to preserve the line of the rail, which is always straight, whether the plane be horizontal or inclined. The wagons, or receptacles for the goods, travel in pairs, one of a pair being on one side of the rail, and the other on the opposite side, as panniers over the back of an ass. By this arrangement, only two wheels are employed (instead of eight) to convey a pair of wagons; these two wheels are placed one before the other on the rail, and the axletrees upon which they revolve, are made of sufficient length, and strength, to form extended arms of support, to which are suspended the wagons or receptacles on each side of the rail, *the centre of gravity being always below the surface of the rail.*

A number of the carriages are linked together, and towed along

the rail by a horse, as barges on a canal. Owing to the undulation of the country, the horse will sometimes be much below the rail, in consequence of which, he is provided with a sufficient length of rope, to preserve a proper angle of draught.

Fig. 1. is an end view of the carriage, with a cross section of the rail, and of a pillar showing its form, and manner of fixing. *Fig.* 2, is a side view of the rail-way passing over an uneven surface, with three of the supporting pillars of unequal length. Upon the upper surface of the rail, are seen the two carriage wheels, and the manner of suspending the wagons, or receptacles, from the axle-trees, which is, however, better shown by *Fig.* 1, letters I, I, I, I, (the same letters refer to the same parts in the different figures.) *Fig.* 3, is a plan of the same, in which the comparative measurements and the mode by which the receptacles are braced together, are clearly shown.

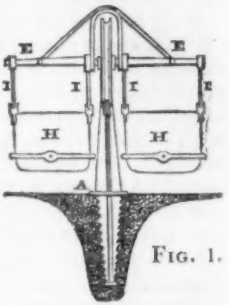


FIG. 1.

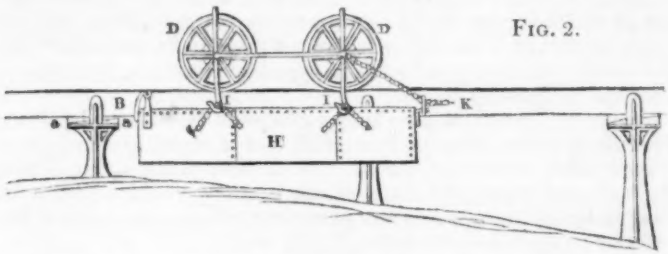
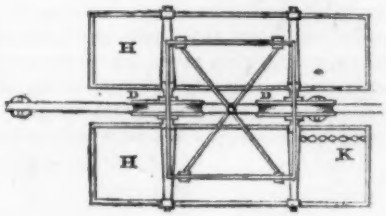


FIG. 2.

A, *Fig.* 1, is an upright pillar of cast iron, having at the shoulder a flanch which rests upon the surface of the ground. The pillar is formed with ribs, at right angles, which converge toward the lower extremity, and are notched on the edges, for the better securing it firmly in the ground, with the broken hard materials which are rammed around it; the hole into which it is inserted being previously well prepared by ramming with a sort of pile driving engine. Three of these pillars are seen at *Fig.* 2, which are placed at about nine feet apart. At the upper extremity of the pillars are long clefts, or openings, to receive the rail B, which is composed of deal planks set on their edges, with the upper surface C, defended by cast or wrought iron plates, a little convex on the upper side.

FIG. 3.



When the rail has been some time in use, and all has taken the proper bearing, a little adjustment of the line may be requisite, before the rail is bolted to the pillars; to effect which, a very simple and easy method is provided. In the cleft of the pillars, and under the rail, two wedges, a a, are introduced, whereby its level may be adjusted with the nicest accuracy.

D D are the wheels, which are provided with flanches on their peripheries to keep them from travelling off the rail. E E are the arms or axles, H H are the receptacles for the goods, which are represented as made of plate iron, and are suspended to the arms or axles (as before mentioned) by the inflexible rods I I I I. To one of the arms, a chain, K, is hooked, to which a towing rope may be connected. Any number of carriages may then be attached together by chains hooked on to the angles.

The landscape is intended to exhibit a portion of the rail-way in use, and the methods by which several of the obstacles which frequently present themselves, are overcome. On the left is seen a jointed rail, or gate, which crosses the road; over which the train of carriages have just passed, and the gate swung back, to leave the road open. The horse and man having just forded the brook, the train of carriages is proceeding in its course, and following another train part of which is seen on the right, crossing the rail-bridge, which is simply constructed for that purpose. Provision is made for trains of carriages that are proceeding in opposite directions, by means of "sidings" or passing places.

Among the principal advantages proposed from the adoption of Mr. Palmer's plan, may be mentioned, that of enabling the engineer, in most cases, to construct a rail-way on that plane which is most effectual, and where the shape of the country would occasion too great an expenditure, on former plans; that of being maintained in a perfectly straight line, and in the facility with which it may be always adjusted; in being unincumbered with extraneous substances lying upon it; in receiving no interruption by snow, as the little that may lodge on the rail, is cleared off by merely fixing a brush before the first carriage in the train; in the facility with which the loads may be transferred from the rail-way on to other carriages, by merely unhooking the receptacles, without displacing the goods, or from other carriages to the rail-way, by the reverse operation; in the preservation of the articles conveyed, from being fractured, owing to the uniform gliding motion of the carriages; in occupying less land than any other rail-way; in requiring no levelling or road-making; in adapting itself to all situations, as it may be constructed on the side of any public road, on the waste and irregular margins of rivers, on the beach, or shingles, of the sea-shore; in places where no other road can be made; in the original cost being much less, than in the ordinary mode; and in the impediments and great expense occasioned by repairs being by this method almost wholly avoided. [*lb.*

Description of the Patent Cat-Block, invented by Mr. THOMAS HILLMAN, *Millway.*

BY the common method of catting an anchor, the anchor being once hooked by the cat-block, the whole process of catting and stopping the anchor, overhauling the cat-fall, and unhooking the block, must be performed before the anchor can be let go again; hence many ships navigate rivers, with the anchor hanging under water, which materially affects the steering of the ship.

By this plan, when an anchor is to be catted, the bite of the stopper is carried forward, to assist in conducting the cat-block to the ring of the anchor. When hooked, the anchor is catted in the usual manner, and the stopper being passed over a cleet at the end of the cat-head, the slack of the stopper is taken up and belayed.

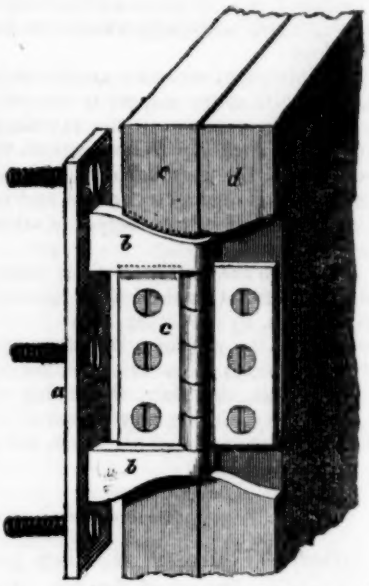
To let go the anchor, nothing more is requisite, than to let go the leading part of the cat-fall, which, by rendering, slowly transfers the weight of the anchor without surging to the stopper, which then unhooks the cat-block. By this plan, therefore, the anchor may be let go instantly, during any period of the act of catting it, and it may be let go, at any height between the cat-head and the water's edge. [*Ib.*

Method of Variegated Weaving, patented by MESSRS. GIBBS *and* DIXON, *of London.* Enrolled July, 1826.

THE object of the patentees, is the fabrication of cloths, (*piece goods,*) having a speckled appearance, and of variegated hues; this is effected by composing the weft or shoot, of two different coloured threads twisted together, which may be of silk, of silk and worsted, or of linen, cotton, silk, and worsted, variously combined. The more the colours are contrasted, the more brilliant, of course, is the effect: long specks or spots are produced by twisting the threads very slightly, and short, or minute ones, by a hard twist. The warp of the fabric, as well as the shoot, may be composed of a similar, or different, arrangement of threads, and thus, by slight variations, a great diversity of pretty patterns may be obtained. [*Ib.*

Improved Hinge for Library Doors.

By the ordinary method of hanging doors to libraries, the hanging stiles are fixed to the vertical partitions of the shelves, and, being necessarily of a greater width than the latter, the books behind them cannot be got out without displacing those adjoining. To remedy this inconvenience, an exceedingly simple and effectual contrivance has been lately adopted.

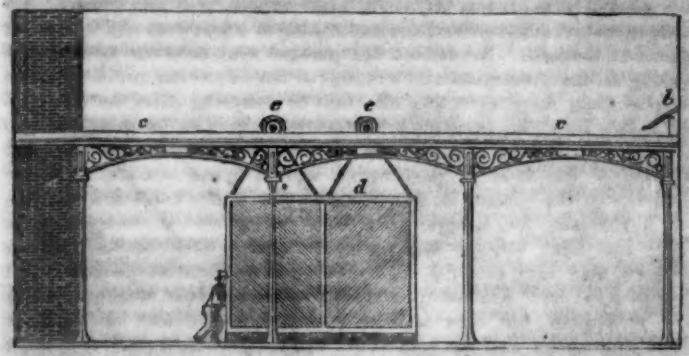


a is a brass plate, which is screwed to an upright partition; *b b* are two projecting parts, (cast in one piece with *a*,) with the extremities rounded off, and perforated to receive the centre pin, which passes alike through them, and the joint of the common *butt-hinge c*. To the flaps of the latter are screwed the doors *d* and *e*, portions of which only are brought into view, to save room. It will be observed that the door *e* lays back quite level with the (supposed) shelves, and that the door *d* folds close against *e*, so as to lie parallel with it, and quite out of the way. This being the case as represented in the figure, it is equally obvious, that when the door *d* is turned back the contrary way, both doors are thereby shut, and lie quite flush and close; and that the door *e* may then in like manner be folded over *d*. The greatest facilities are thus afforded by a *single* hinge, instead of *two* hinges, and without the necessity of any additional hanging stile.—Upon the whole, we trust our readers will think with us, that this is a very clever little contrivance, and may be applied, with similar advantages, in many other situations besides library doors. [*Ib.*

Description of the Suspension Gates, erected at the London Docks, by H. R. Palmer, *Engineer.*

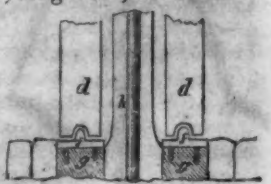
Mr. H. R. Palmer, the inventor of the suspension rail-way, has recently erected at the London docks, some sliding, or rather roll-

ing gates, which he has suspended in the way he proposes to suspend the carriages, in the former invention. In opening or shutting them, nothing need be moved out of the way, and it is done with great facility and despatch. Being suspended entirely from above, and not even touching the surface of the ground, they are not subjected to the adventitious obstacles common to other gates.



a is intended to represent part of the wall of the ranges of warehouses, and *b* the extremity of the range of sheds, on the opposite side of the avenue. *c c*, a double rail-way, extended entirely across the avenue from *a* to *b*, and likewise to the width of a gate beyond, on each side; it is supported by slightly curved arches of wrought iron, with ornamental scroll work between the arches and the double rail, the superstructure resting upon lofty columns of cast iron. One of the three gates *d*, (each of which fills up the space between two columns,) is shown in the act of being closed, by a man pushing it along: from its large dimensions and great weight, (though chiefly composed of wood,) this could not be easily effected by the simple force of one man; but being constructed on the principle of Mr. Palmer's patent rail-way, (a full description of which is given in the present number,) the friction is reduced to a very inconsiderable amount, the whole weight of each gate, being entirely suspended by iron rods, to the axles of the little wheels which run on the top of the rail-way, which are kept in their track by their peripheries being flanched.

The gates do not rest upon, or even touch, the ground, but are merely guided in their course, by means of a projecting edge fixed in their path: this will be easily explained by means of the annexed diagram, which represents a transverse section of these parts. *f f* are two plates of iron, with raised edges in the middle, which are screwed down to oaken sleepers *g g*; and above these, is shown an edge view of the lower ends of the gates, which run on either side of the column *h*. [*Ib.*



Description of a Fog Azimuth Compass, invented by Lieutenant GEORGE LINDESAY, R. N.

THE many losses of valuable ships, and lives, which have occurred to all nations, and which are still liable to occur, from the mariner being unable to ascertain his ship's exact situation at sea, in foggy and hazy weather, *when no horizon can be seen*, is a truth too well known to admit of dispute. Neither in the present system of navigation, nor among all the inventions and writings of the numerous authors on that subject, does there exist any effectual or unerring plan, for extricating a ship from this perilous predicament, which so frequently eventuates in the destruction of fleets, the interruption of commerce, and the loss of the lives of passengers, and of brave seamen. As the visibility of the horizon at sea, is necessary to the calculation of the sun's altitude, the danger of a ship being lost or misguided, in foggy and hazy weather of long continuance, when no horizon can be seen, may very easily be conceived. To arrive at the important desideratum now alluded to, some experiments have been suggested and attempted, but they have all proved inefficient. To obviate these difficulties and uncertainties, the present invention is offered to those interested in nautical affairs; the apparatus is very simple and convenient, and should it prove sufficiently accurate, it will be a very valuable acquisition to the science of navigation.

It consists merely of a telescope, attached to a common compass box, supported upon a tripod, and furnished with a magnifying glass, for reading off the divisions. This fog compass may also be occasionally used to give the place of the ship in clear weather, should the vessel be without sextant or quadrant, or those instruments out of repair.

Application.—In using this compass, it is recommended to take two bearings of the sun, as near to the meridian as possible, and to note the elapsed time by a chronometer or good watch, and then to proceed in the usual way, to calculate from these data the sun's meridian altitude, which will give the latitude, and the apparent time, which being compared with Greenwich time, will give the longitude.

ESSAYS ON LITHOGRAPHY.—No. VI.

Engraving on Stone, by indenting lines similar to engravings on copper. (en creux.)

For this species of engraving, which differs but little from that ordinarily effected upon copper, a perfectly polished and homogeneous stone is selected; upon this, nitric acid, diluted with water, is poured, which operation is sometimes repeated several times, according to the strength of the solution. It is important that it be spread with great regularity, over every part of the stone; and in order to effect this, the stone is held a little inclined, and the liquid poured from a glass having a large orifice. As a general rule for judging of the strength of the acid, a little of it may be applied on the end of the tongue, and if the sensation produced be about equal to that excited by very strong vinegar, it will answer the purpose. A drop of the mixture allowed to fall upon a lithographic stone, ought not to produce a strong and rapid effervescence, but the bubbles of air should be minute, and succeed each other slowly: a much more powerful acid, however, may be used in this species of engraving, than when ink, or crayons, are employed.

When the stone has been prepared by the aqua-fortis, it is to be washed with a sponge, and then rubbed over with gum water, containing about a fourth part of sugar-candy, or of honey, varying the proportion according to the humidity of the season. This coating of gum, which should be extremely thin, is suffered to become partially dry, and when it has assumed a sufficient consistency, lamp-black is to be rubbed over it, by means of a soft flat brush, about the width of three fingers; this must be carefully done, and with a light hand. The gum becomes impregnated with the black colour, forming a coating of equal thickness, and upon this the engraving is to be performed. If a coating of red is preferred, this may be produced by substituting finely ground red ochre, which may be incorporated with the gum water, adding a little sugar-candy, to render the coating less brittle, and to allow the point to enter with greater facility. The black ground will be found the most convenient, as it contrasts better with the white lines, which the artist produces in cutting the stone with the point. Sometimes the black colour is mixed up with the gum water, and spread upon the stone with a brush, or a sponge; but this manner of proceeding requires considerable address and experience.

When the ground with which the stone has been covered is sufficiently dry, and the design has been transferred to it, the engraving may be commenced; this is effected in the same manner as upon copper, observing, however, that the tracing upon stone should be less deep, for if the lines were cut down, as they are upon copper, the printing ink would not pass into them, or would not be taken off by the paper, in the operation of printing. Sharp and blunt points must be provided, of different sizes, in order to produce fine or broad

lines, according to the nature of the work; for those which are broad, the point must be flattened at the end, and sharpened so as to terminate in right angles, in order to give to all the lines, an equal depth in every part. In tracing upon the stone, a white powder is produced, which must be removed by a soft brush, or a squirrel's tail, to enable the artist to judge correctly of his work. It must be recollected, that the traces will appear broader upon the stone, than they are in reality. By care, and practice, an engraving upon stone may be produced, which will be very nearly equal, in delicacy and fineness, to those which are executed upon copper.

In the art of engraving on stone, particular care must be taken to protect it from the action of the breath, from the mouth and nostrils; and also from the moisture of the hands. The former is effected by using a disk of tin, or of pasteboard, having a small piece of wood in its centre, which may be held in the mouth. A piece of thick paper, or of leather, will prevent injury from the hands. Should the stone become humid from any cause, the gum may spread itself, so as to pass into the lines which have been traced, and thus prevent the adherence of the printing ink.

When the engraving is completed, the lines are to be inked; to accomplish which, a pencil dipped in linseed oil, is lightly passed over them; this disposes them to receive the ink readily. The stone is suffered to remain in this state for two or three minutes, when the oil must be removed by covering it with blotting paper, and pressing upon it with the hand. After the removal of the oil, the traces are to be filled with printing ink, mixed up with a small portion of tallow; this operation should be performed quickly. The gum is to be removed by moistening the stone with water, and rubbing it with a sponge. When it is perfectly clean, the inking roller is to be passed over it; this must be charged with ink in larger quantity, and more fluid, than usual; impressions may now be taken in the ordinary way.

Instead of filling the traces with oil, in the manner prescribed, the following composition is sometimes used. Equal parts of tallow and of bees'-wax are taken, to these are added a small portion of oil, and of lamp-black, the whole of which are melted together, and well incorporated; the lines are filled with this composition by means of a sponge: the gum is then removed, and the impressions taken. This manner of proceeding is preferable to the former. If there are any faults in the engraving, these are to be repaired by lightly scraping the stone, preparing the part so scraped, covering it with a coating of gum, and engraving as in the first instance. Whenever impressions are taken from this species of engraving, the paper must be more freely wetted, and the pressure be more powerful, than is requisite in either of the other modes.

This method of engraving presents some advantages over that upon plates of copper; for, although the execution cannot be made equally fine, it excels in that softness which is so agreeable to the eye. The rapidity with which it is executed is very great, as it is only necessary to spread the gum, and to trace the lines; with a single stroke

of a flat point, they are made of the desired widths, without the necessity of cutting, and recutting, a number of times. This mode is peculiarly adapted to geographical charts, and architectural designs. There has recently been invented, a machine which will trace lines exceedingly fine, and close to each other; and by its aid every species of design consisting of straight lines, may be executed, particularly back grounds, skies, and machinery in general. The art of engraving upon stone has been much neglected in France; yet this species is capable of furnishing very beautiful work, and that in a very economical manner. It is to be hoped that our artists will hereafter turn their attention to this interesting part of lithography.

It is not thought necessary to treat upon the process of engraving upon stone, by means of aqua-fortis, in the manner followed with copper. It does not appear to present any particular advantages, and besides, any person familiar with the other processes in lithography, would, after a few trials, readily succeed in this.

Imitation of Wood-cuts.

A perfect imitation of wood engraving may be produced lithographically. For this purpose a well polished stone is to be thinly, but evenly, covered with lithographic ink, observing that every part be rendered black by it. Upon this ground the design is to be transferred, or it may be sketched with a red crayon; when those parts which are to appear white upon a black ground, are to be removed by the aid of scrapers, points, and gravers, of different sizes. To produce the intended effect the stone need not be deeply cut; all that is necessary being the entire removal of the ink from those parts which are to appear white in the impressions. This proceeding is exactly the reverse of that followed in engraving by cutting lines on copper, or on stone. It is only where the drawing covers nearly the whole ground, with but a small proportion of white, or blank parts, that we work in this way: when the reverse is the fact, the design is transferred, or drawn with a pencil upon the bare stone; the lines are then covered with ink by means of a pen, or a pencil, as they are to appear when printed, those which are to appear white, remaining untouched. Those parts of the design which require light lines, may either be so drawn in the first instance, or a portion of the ink may be removed by means of the point, from the parts which are too strongly marked; this will always be determined by the nature of the work, which may sometimes be executed more easily, or more rapidly, by one than by the other of these methods. The portions of ink taken off by the point, or by the scraper, must be carefully removed with a hair pencil, for should they insinuate themselves between the black lines, or adhere to the naked stone, the impressions will be defaced by corresponding spots.

When the drawing is completed, the stone is to be prepared by a slightly acidulated water. This method allows, more readily than any other, of the rectification of any errors which may have been committed; it is only necessary to cover any defective part with lithographic ink, and to repair it in the way in which the work was

at first performed. Etruscan vases upon a black ground are remarkably well represented in this way; the vases may afterwards be coloured by using a second stone. Arabesques, vignettes, visiting cards, and numerous other devices may also be produced by the same process.

There is another method of proceeding, which is by forming the lines of the drawing, with some deep transparent colour, mixed with gum water. Indian ink answers the purpose extremely well: those called body colours are apt to imbibe the oil which is rubbed upon the stone. When the drawing is quite dry, linseed oil is rubbed upon the stone, and is allowed to remain for seven or eight minutes, that it may be imbibed by those parts which are uncovered, and which is to form the ground. This oil is to be removed from the surface by rubbing it with a piece of soft linen; water is then poured upon the stone, in order to remove all the lines of the drawing, when it may be prepared by aqua-fortis, and impressions taken from it. This procedure leaves the lines white, upon a ground of black. The same kinds of work may be executed in this way, as by the former, and instead of black, the ground may be of any required colour.

ON JAPANNING AND VARNISHING.—No. 7.

On making colourless Lac Varnish by two different methods.

In our 4th volume, p. 130, we published Professor Hare's method of Bleaching Lac, so as to make a colourless varnish. We then stated that the Society, established in London, for the Encouragement of Arts, Manufactures, and Commerce, had continued to offer a premium of a gold medal, or thirty guineas, for the discovery of a process which should accomplish this object. Two applications for the premium have recently been made to the society; one of them by a gentleman of the name of Field, the other by a Mr. Luning. The processes of these gentlemen differ from each other; and it is stated in the account published by the society, that the method pursued by each of the applicants appearing to answer the intended purpose, it has been thought proper to give the reward for both of them.

Mr. Field's process for Bleaching Lac.

Six ounces of shell-lac, coarsely pounded, are to be dissolved by gentle heat in a pint of spirits of wine. To this is to be added a bleaching liquor, made by dissolving purified carbonate of potash in water, and then impregnating it with chlorine gas, till the silica precipitates, and the solution becomes slightly coloured.

Of the above bleaching liquor add one or two ounces to the spiritous solution of lac, and stir the whole well together; effervescence takes place, and when this ceases add more of the bleaching liquor, and thus proceed till the colour of the mixture has become pale. A second bleaching liquid is now to be added, made by diluting muriatic

acid with thrice its bulk of water, and dropping into it pulverized red lead, till the last added portions do not become white. Of this acid bleaching liquor small quantities at a time are to be added to the half bleached lac solution, allowing the effervescence which takes place on each addition to cease before a fresh portion is poured in. This is to be continued till the lac, now white, separates from the liquor. The supernatant fluid is now to be poured away, and the lac is to be well washed in repeated waters, and, finally, wrung as dry as possible in a cloth.

The lac obtained in the foregoing process is to be dissolved in a pint of alcohol, more or less, according to the required strength of the varnish; and after standing for some time in a gentle heat, the clear liquor, which is the varnish, is to be poured off from the sediment.

"White lac varnish," says Mr. Field, "as above prepared, and used in a temperature of not less than sixty degrees, dries in a few minutes, and is not afterwards liable to chill or bloom; it is therefore applicable to drawings and prints which have been sized; and may be safely and advantageously used upon oil-paintings which have been painted a sufficient time, as it bears out colour with the purest effect. This quality prevents its obscuring gilding, and renders it a valuable leather varnish to the bookbinder, to whose use it has already been applied with happy effect, as it does not yield to the warmth of the hand, and resists damps, which subject bindings to mildew.

"As lac is the basis, even in name, of all the metallic lackers, colourless lac may afford silver and steel lackers, with little or no obscuration of their lustre. Its varnish polishes better than any other, and is applicable to some uses of the jeweller, to which purpose it has also been applied, as it has also, successfully, to the varnishing of light-coloured woods, and cabinet work, to which it is applicable in the manner of French polish; and there can be no doubt it would afford coloured lackers and varnishes of superior quality. In fine, the white lac varnish is generally applicable to the various purposes of other white hard spirit varnishes, and is to be used under the same conditions, and with the same management."

Various certificates, from persons who have used the varnish, follow the description of the process by which it is made. One manufacturer, it appears, had offered one hundred pounds for the process. The varnish is stated to be perfectly colourless, hard, and transparent; to dry rapidly, and to be perfectly free from tackiness, and from the vice of *blooming* (decomposing by moisture) so troublesome in white spirit varnishes in general.

Mr. Luning's process for Bleaching Lac.

Dissolve five ounces of shell-lac in a quart of rectified spirit of wine; boil for a few minutes with ten ounces of well burnt and recently-heated animal charcoal, when a small quantity of the solution should be drawn off, and filtered; if not colourless, a little more charcoal must be added. When all colour is removed, press the

liquor through silk, as linen absorbs more varnish, and afterwards filter it through fine blotting-paper.

In cases where the wax contained in gum lac would be objectionable, filter cold; if the wax be not injurious, filter while hot.

On comparing Mr. Luning's varnish with Mr. Field's, in the state in which each was sent to the society, the former was of a much thinner consistence, and was rendered turbid, by scales of wax and a few particles of charcoal floating in it. On passing it through common white filtering paper, the impurities were separated, and the liquid came through in a more completely colourless state than Mr. Field's. This seeming advantage was, however, owing to the much greater state of dilution of Mr. Luning's varnish; for, when brought by evaporation to the consistence of Mr. Field's, they each appeared as nearly as possible of the same very pale yellowish tint; so that for the use of the painter and varnisher they may each be called equally colourless.

Mr. C. Varley having made some interesting comparative experiments on the two varnishes, his letter to the secretary, detailing the same, is here added.

March 31, 1827.

Sir,—I have varnished some of my sketches with Mr. Field's lac varnish, and some with Mr. Luning's ditto.

Mr. Field's varnish appears to me to answer all that can be expected from a varnish. It may be laid on as freely as any other varnish, and dries quick, brilliant and transparent. It is superior to all other varnishes in its approach to a glassy surface, and in freedom from tackiness. It is about a right strength or body, though I prefer a sample I had before from Mr. Field, which is as thick as can be laid on; for it is desirable for a varnish to be as thick as will allow time for it to be spread on, because it then thickens so soon, that its solvent has no time to act on the oil or colours of the picture.

Mr. Luning's varnish is a great deal too thin, and therefore requires two or three coats before it will bear out; and then, owing to its thinness, the activity of the spirit softens the first coat of varnish, and renders it uneven. It is not so brilliant as Mr. Field's, owing to the mixture (not solution) of wax, and is rather dirty, from the wax retaining some of the charcoal. Therefore I most decidedly give the preference to Mr. Field's varnish.

I have succeeded in throwing down both the wax and charcoal by adding spirit (essential oil) of turpentine, which dissolves the wax, and the solution then becomes sufficiently heavy to separate from the varnish; it requires at least one of spirit of turpentine to three of the varnish before the former is heavy enough to separate, and then it is scarcely a liquid, and separates very slowly; but if more spirit of turpentine is added, it goes down quicker. The varnish dissolves a small portion of the spirit of turpentine, which I feared might be an evil, when drying: but I cannot perceive that it makes any difference. Mr. Luning's varnish, when so freed, appears more colourless than Mr. Field's; but, if brought to the same strength, there

would be very little difference; but probably a union of the two processes may produce the varnish like water, though the colour of each is at present equal or superior to most of the varnishes now in use, and will therefore stand at the head as the chief varnish.

I am, sir, &c.

A. Aikin, Esq., *Sec.* Cornelius Varley.

In the Philosophical Transactions, vol. LXXXIV. is a chemical examination of lac by Mr. Hatchett, from which it appears, that one hundred parts of shell-lac consist of 90.9 resin, 4 wax, 2.8 gluten, and 0.5 extract. Cold alcohol will take up eighty-one parts of the resin, and leave the wax and gluten untouched; it would, therefore, probably, be an improvement on either of the above processes, to make the first solution of the shell-lac in cold, instead of in warm or boiling alcohol.

The first of the foregoing processes, it will be seen, bears a strong analogy to that of Professor Hare, which he invented some years since. The new process is objectionable on account of its requiring the lac to be twice dissolved in spirits of wine, which greatly enhances the cost of the varnish, the first portion of spirit being necessarily lost, as it would be a folly to attempt its recovery. We do not think that the subject is exhausted, but that the successful attempts to bleach this valuable resin, will lead to processes which will be more economical than either of those now before us, neither of which will be generally adopted.

Perhaps the lac might be bleached, by making a solution of it in potash, as practised by Dr. Hare, and then applying the animal charcoal, as used by Mr. Luning. The lac might then be precipitated by sulphuric, or some other acid, and afterwards dissolved in alcohol. Should this plan succeed, it will possess some advantages; we fear, however, that the animal charcoal will not be easily separated, nor will the process be simplified to the extent which we still hope it may attain.

Notice of Mr. Bull's '*Defence of the Experiments to determine the comparative value of the principal varieties of Fuel, used in the United States,*' *&c.*—Philadelphia, Judah Dobson, Chesnut Street.

In the first volume of this Journal, we published the "*Experiments to determine the comparative quantities of Heat evolved, in the combustion of the principal varieties of Wood and Coal, used in the United States, for fuel: and, also, to determine the comparative quantities of Heat lost by the ordinary apparatus, made use of for their combustion.—By* Marcus Bull." This memoir had been read before the American Philosophical Society, and was immediately published in their transactions. It has since issued from the press in a separate form, and is therefore known to most scientific gentlemen.

In page 133 of our present volume, will be found an account of a

premium founded by Count Rumford, to be given once every second year "to the author of the most important discovery, or useful improvements on heat, or on light, the preference always being given to such discoveries as shall tend most to promote the good of mankind." This trust was invested in the American Academy of Arts and Sciences, established in Boston. Although this premium was founded thirty years ago, its existence has not become generally known, even to persons engaged in the pursuit of the physical sciences: Mr. Bull, it appears, had been employed in the prosecution of his experiments, during six months, when he accidentally heard of it, and was advised to prefer his claim as a candidate for its bestowal. After completing the intended series of investigations, and publishing them, as directed by the Count, this application was made to the Academy, and referred to a committee. The work before us, is a pamphlet of about 50 pages, and contains an extended correspondence with this committee; their report, with remarks thereon, and animadversions on the manner in which the trust confided to the Academy, has been managed.

The objects proposed by Mr. Bull in undertaking his experiments, placed him, in the most direct manner, in the situation of a legitimate claimant, as this object was to "promote the good of mankind," by ascertaining the relative value of articles used as fuel, and which are perpetually called for by the necessities and habits of civilized man. The only question, therefore, to be determined, was, whether these experiments had been so performed as to accomplish their purpose; the committee, it appears, thought they had not, whilst Mr. Bull, and a number of his scientific friends, entertained a contrary opinion.

In order to attain the highest degree of accuracy of which the experiments were susceptible, Mr. Bull had a room of wood constructed within one of the chambers of his house; within this interior room his experiments on the heat evolved in combustion were performed, whilst the outer room was kept at a temperature of ten degrees below that of the interior, in which his essays were made; the intention of this arrangement was to obviate that uncertainty which would have resulted from any notable change of temperature, in the external atmosphere, during the progress of any experiment. The committee say, that although the atmosphere of the exterior room may be constantly kept at the uniform difference of 10 degrees below that of the interior, yet the *walls* of the two will not remain at the same difference at their opposite surfaces, as a reduction of temperature out of doors, will cool not only the outer, but also the inner surface of this wall, and thereby cause a greater radiation of heat to it, from the wall of the interior room, than when the atmosphere remained stationary from the beginning. As it was manifestly possible to ascertain any *appreciable* difference in the temperature of these two walls, Mr. Bull proposed to subject the validity of the objection to the test of experiment, contending that if this difference was inappreciable, the objection must be considered as invalid; and that although it might be theoretically true, the practical accuracy, and

consequent utility of his results, would remain unimpeached. To the proposed test the committee demurred, and appeared to consider that their decision ought to turn upon the *theoretical* truth of their objection, as they do not limit it by 'the extent of an *example*,' but upon the truth of a *general principle*.

Mr. Bull subsequently ascertained, by a method which appears to us to be remarkably accurate, that when the difference of the temperature of the room, and that of the external air, was 30°, the difference of the heat of the surface of the wall within the room, and that of the air in contact with it, was so small as not to affect the most delicate instruments, ordinarily used for measuring differences of temperature.

It would seem to us, that the reasoning of the committee would inevitably lead to the conclusion, that it is impossible so to experiment upon the subject of Mr. Bull's inquiries, as to obtain any information which "shall tend to promote the good of mankind," and that we must ever remain in utter ignorance, of the relative value of the different kinds of fuel; as every experiment must, of necessity, be performed in places where there are radiating substances, and where radiation to a greater or lesser extent must be perpetually taking place. Indeed, the committee seem to have drawn this conclusion themselves, as in reply to a request that they would suggest what they would consider as satisfactory experiments, to determine the point in dispute, they observe, that they know of no experiments which can remove the difficulty.

A long continued series of experiments and observations made without the precautions observed by Mr. Bull, by employing in a common room, some of the ordinary apparatus for the combustion of fuel, might, from an average estimate of their results, furnish important practical information, although the accuracy of every individual trial should be far inferior to any one of those obtained by Mr. Bull. If this be admitted, it would require a complete inversion of all the ordinary modes of reasoning, to infer that experiments made with a minute attention to accuracy, by removing, as far as possible, every source of error, 'are of no practical value,' excepting they bear in every point, the rigorous test of a mathematical demonstration; a test which belongs not to the science of physics.

We have in the foregoing remarks, manifested our favourable opinion of the experiments of Mr. Bull, and with the exception of the committee of the Academy, we are not acquainted with a single man of science, whose impressions are not similar to our own. The experiments have been re-published in Europe, and have been viewed as models for future experimenters; if we err, therefore, we have the sanction of good company; and as the opinions expressed have not been formed, without a competent acquaintance with the principles involved, and a careful investigation of the subject, they must remain unchanged, until some better reasons are urged against them, than any which we have yet seen.

The concluding part of the defence, is devoted to an inquiry into the manner in which the academy has managed the trust committed

to it, by Count Rumford. This premium, which was directed to be bestowed biennially, on "the author of the most important discovery, or useful improvement, which shall be made, and published by printing, or in any way made known to the public," has never been awarded, although, nearly thirty years have elapsed, since the time at which it should have been first given; it has in consequence accumulated, until, instead of a premium of 300, it now amounts to upwards of 2000 dollars biennially; a circumstance which tends to defeat the intentions of the donor, as it naturally and necessarily renders the academy averse to its bestowal in cases where the smaller sum would have been readily awarded. The following are the concluding remarks upon this point.

"It was the plain and evident intention of Count Rumford, that the premium should be awarded to the author of the *most important* discovery, or useful improvement, on the subject of *heat* or *light;* and there can be no doubt, that those subjects are susceptible of discoveries and improvements, of such a nature as was contemplated by the donor. Yet the Academy has never awarded the premium, and seems to act under the impression that no discovery or improvement of the kind can be made. What then is the plain duty of the Academy? If its opinion be, that the trust cannot be executed, that opinion ought to be announced in the most public manner; that the fund which is in the hands of the trustees, may go, where of right it belongs, to the representatives of Count Rumford. If no such opinion as this exists in the Academy, or if the opinion does exist, and is unsound, the Academy ought to execute the trust. To them is imparted, by the donor, the power of awarding the premium to the most important discovery or useful improvement; and consequently the power of judging; but this power is to be guided by a sound discretion, and to be exercised under a due sense and a just observance of the trust reposed in them. These then are questions, which the Academy is bound to answer, and to answer satisfactorily—how is it, and why is it, that this premium has never been awarded? how is it, and why is it, that this trust is not executed? how is it, and why is it, that scientific men are invited to direct their efforts, prosecute their researches, and exercise their faculties, on these subjects, under a delusive hope and promise of distinction and reward, which can never be attained?"

Mr. Bull owed it to his own reputation, to defend the well earned fame which his experiments had acquired for him, and we think that he has been eminently successful in the attempt; that he has made out a fair case, and shown that the objections urged by the committee, are of that hypothetical character, which a little ingenuity may raise in every similar case.

FOR THE FRANKLIN JOURNAL.

Observations on a Cement used in Spain, for the Preservation of Ships' Bottoms.

Charleston, S. C., March 10th, 1828.

Sir,—Although a distant subscriber, I have taken much interest in the success of your very valuable Journal, so well calculated to convey useful information among practical men, like myself. The observations by Mr. Gill, 'on various cements,' have brought to my recollection a circumstance which occurred some years ago, under my own observation; and I have thought that the publication of it might be of very material benefit to the marine department, and shipping interest of our country.

I am a practical shipwright, and have been constantly engaged in building and repairing vessels for twenty-eight years; in the year 1804, a large Spanish ship, which required considerable repair, arrived in this port, and was committed to my charge. On taking the old sheathing from the bottom, I found a coat of plaster, or chinam, which adhered so firmly, that it required considerable exertion to dub it off with the adze. It not only adhered to, but appeared to have become incorporated with the main bottom; its hardness was about equal to that of soft marble, or plaster of Paris, in its natural state. This cement had been on the ship's bottom for many years; and the captain, an elderly man, who was a native of Biscay, in Spain, requested that a similar covering should be again applied; on my expressing my ignorance of the nature of the preparation, he offered, with the assistance of the cook, to make the mixture for me, and desired that I would have two plasterers ready, with their trowels, to apply it, when the ship was in a state of readiness to receive it.

The composition he made as follows. The best barrelled stone-lime was taken, and slaked, by pouring on it just enough fresh water to produce that effect, and to cause it to fall into a dry white powder: this, when cooled, was sifted through a fine wire sieve, into a trough like a bread trough; there was then added to it, a portion of common fish oil, sufficient to bring it to the consistence of soft putty, so as to work with ease under the trowel. No water whatever was used, excepting that for slaking the lime in the first instance.

On the second day of sheathing, the plasterers had put on the width of two or three streaks, all fore and aft, more than we could cover, and this portion I concluded would wash off in the night, after we had righted the ship. The captain laughed at my fears, and said he would vouch for the cement being there in the morning, and to my no small surprise I found this to be the case. It had acquired a tinge of yellow, and was much harder than when put on, although it had been covered with the salt water during the whole night. The captain assured me that it would soon attain the hardness of that which had been removed.

The ship was one of about 450 tons, and, as nearly as I can recollect, the quantity of material used, was about five casks of the

unslaked stone-lime, and I think, three sixty gallon casks of oil. I am not certain on this point, although I cannot err greatly; the consistence which the mixture must have, will be a sufficient guide for the proportions. In the process of making, and applying it, the information which I have given is perfectly correct. After it is prepared for use, it is kept in covered vessels to preserve it from the rain, or other moisture. The ship's bottom is prepared for sheathing in the usual way, by being paid with a coat of good half stuff, and allowed to cool, before the plaster is put on, as this accelerates its adhesion to the main bottom.

Although it is out of my province, and I am therefore unable, to form a judgment on this point, I have thought it worth inquiry whether this cheap cement might not be substituted for the costly Roman, or Dutch water cements. It would be worth the trial, whether it would not harden in fresh, as well as in salt water, and answer the purpose of building piers, locks, and other structures under water.

If you think these remarks likely to be useful, please to insert them, and oblige,

Yours, &c.

James Marsh.

On the cause of the Diurnal Fluctuations of the Barometer.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir,—Some years ago I communicated to the American Philosophical Society, a paper explanatory of the diurnal fluctuations of the Barometer. As that paper has not appeared in their transactions, and as no satisfactory explanation of this phenomenon has appeared elsewhere, although it has been attempted by Professor Leslie and others, I send you the substance of it now for publication.

The phenomena, as observed by many philosophers, in the East and West Indies, and in various parts of the torrid zone, are the following:—

From 6 to 10 in the morning, the barometer rises,
From 10 to 6 in the afternoon, it falls,
From 6 to 10 in the evening, it rises,
And from 10 to 6 in the morning, it falls.

Many years ago, Dr. Balfour instituted, at Calcutta, a most laborious course of observations on this subject, in which the height of the barometer was noted almost every half hour, for one lunation; and the preceding phenomena were observed, with but two or three slight exceptions. Humboldt observed nearly the same phenomena in the West Indies.

The cause of this fluctuation is so plain, that it is strange it did not occur to either of those philosophers. But it is still more strange that Mr. Leslie, who has done so much for meteorology, should have assigned so inadequate a cause as the sea breeze for this phenomenon.

Nor has Mr. Daniell been successful in his attempt to elucidate these fluctuations by his laborious theory of the polar winds.

The true cause of this phenomenon is the expansion, and, of course, rise of the atmosphere by heat, and the contraction and consequent fall of the atmosphere by cold. Suppose just before sun-rise in the torrid zone, the temperature of the air neither increasing nor diminishing, and of course the air neither expanding nor contracting, the barometer stands at 30 inches; now when the sun rises at 6 o'clock the air will begin to be heated near the surface of the earth, and of course, by its expanding, will elevate the superincumbent atmosphere; and this, by its inertia, will re-act on the air below, and thus press harder on the mercury of the barometer, than if it were at rest—and the more rapidly it is forced upwards, the greater will be its re-action downwards, and of course the more will the barometer be affected. It is manifest that the most rapid increase of heat and rarefaction of the air will take place somewhere between sun-rise and three o'clock, when the heat is the greatest, and this will evidently be near ten o'clock, at which time the barometer will stand highest. Though the heat is still increasing, and of course the air expanding, yet the rapidity of increase after this hour is not so great, and therefore the barometer will begin to fall, and at the moment of greatest heat, when the air is neither expanding nor contracting, the mercury will again stand 30 inches high. But now the air begins to contract from cold, and the mercury will therefore continue to descend, and the rapidity of the descent will be in proportion to the rapidity of the contraction from cold. Perhaps this effect may be more clearly understood by imagining an extreme case. Suppose the lower strata of atmosphere suddenly annihilated, the mercury of the barometer would be relieved from all pressure for a moment, and fall down into the basin; and if annihilation removes all pressure from the mercury, a contraction of the lower strata by cold will remove some pressure, therefore the mercury will fall—at the moment therefore of a most rapid decrease of heat, which is probably near sunset, the mercury will stand lowest, and will be below the height of 30 inches, at which I have supposed it to stand when the air is neither expanding nor contracting. The mercury will now begin to rise, for the rapidity of contraction diminishes from this moment, and the upper parts of the air are permitted more and more to press upon the lower with their whole weight, and even when the contraction ceases below, the upper parts having acquired a velocity downwards, are inclined to continue that motion, and thus by their momentum will press upon the lower parts with a force greater than their natural gravity, and thus the barometer will rise above 30 inches, at which height it was supposed to stand when the air was neither contracting nor expanding. This effect must take place sometime in the night, and it seems probable, a priori, that it would be about ten or twelve o'clock. Now, as the mercury at this hour stands higher than it does by the natural weight of the air at rest, it is plain that it will begin to fall as soon as the force of the superior parts of the air begins to spend itself on the inferior, and when all motion downwards has ceased, the mercury

will again be pressed by the natural weight of the atmosphere, and so stand at 30 inches. In this situation the sun will rise upon it, and the same fluctuations will be renewed.

J. P. ESPY, Prof. Lan.

Philadelphia, March 1st, 1827.

Postscript.—Since writing the above, I have seen the remarks of a very able writer in the American Quarterly Review, on Mr. Daniell's theory: as the reviewer seems to think Mr. Daniell's theory satisfactory, I will merely add that it is not true, that "the first effect of an increase of heat in the atmosphere will be to diminish its pressure," (see page 8 of last American Quarterly Review;) but, on the contrary, the first effect of heat will be to increase the pressure, and cause the air to move outwards and upwards, from where it is heated, and the current will not begin to run towards the heated part until the whole column of air, over this part, becomes lighter by some of the superior parts rolling off from their greater elevation.

On the construction of a Kite, for effecting a communication between a stranded Ship and the Shore, or under other circumstances, where badness of weather renders the ordinary means impracticable. By CAPTAIN DANSEY.

A SAIL of light canvass or holland, is cut to the shape and adapted for the application of the principles of the common flying kite, and is launched from the vessel or other point, to windward of the space over which a communication is required, and as soon as it appears to be at a sufficient distance, a very simple and efficacious mechanical apparatus is used to destroy its poise, and cause its immediate descent; the kite remaining, however, still attached to the line, and moored by a small anchor, with which it is equipped.

The kite, during its flight, is attached to the line by two cords, placed in the usual manner, which preserves its poise in the air; and to cause its descent, a messenger is employed, made of wood, with a small sail rigged to it. The line being passed through the cylindrical hole of this messenger, the wind takes it rapidly up to the kite, where, striking against a part of the apparatus, it releases the upper cord, and by that means, the head of the kite becomes reversed, and it descends with rapidity.

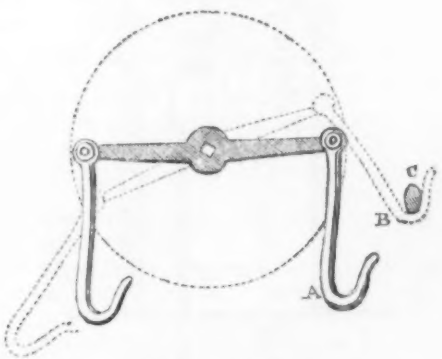
In the experiments made by Captain Dansey, with a view of gaining communication with a lee-shore, under the supposition of no assistance being there at hand, a grapnel, consisting of four spear-shaped iron spikes, was fixed to the head of the kite, so as to moor it in its fall; and in this emergency, the attempt of some person to get on shore along the line, would be the means resorted to. In those cases where a communication has been gained, and the maintainance of a correspondence has been the object, the person to windward has attached a weight to the messenger, in some cases as much as three

pounds, which, having been carried up, has, of course, descended with the kite; the person to leeward has then furled the sail of the messenger, and loaded it with as much weight as the kite could lift, then replacing the apparatus, and exposing the surface of the kite to the direct action of the wind, it has rapidly risen, the messenger running down the line to windward during its ascent.

The kite with which Captain Dansey performed the greater part of his experiments, extended 1100 yards of line $\frac{5}{8}$ of an inch in circumference, and would have extended more, had it been at hand. It also extended 360 yards of line $1\frac{3}{4}$ inch in circumference, and weighing 60lbs. The holland weighed $3\frac{1}{2}$ lbs.; the spars, one of which was armed at the head with iron spikes, for the purpose of mooring it, $6\frac{3}{4}$ lbs., and the tail was five times its length, composed of 8 lbs. of rope and 14 lbs. of elm plank. A more particular description of Captain Dansey's apparatus, may be found in the 41st volume of the Transactions of the Society of Arts, (published in 1823) who presented him with their gold Vulcan medal, for his valuable invention, and communication.

Description of the Centrifugal Check-Hooks, to prevent accidents in raising articles from Mines, &c. Invented by EDWARD SPEER, Esq.

THIS contrivance forms part of an apparatus for preventing accidents in raising men and minerals up the shafts of mines. The numerous disasters which have happened in consequence of the *ropes running wild*, as it is called, has caused several plans to be devised for the security of those engaged in these works. Some of these have been too complex for general adoption, but against that here represented, this objection does not lie. Mr. Speer was rewarded by the Society of Arts, for this invention.



A bar is fixed on the end of an axis. Two hooks, as A, swing

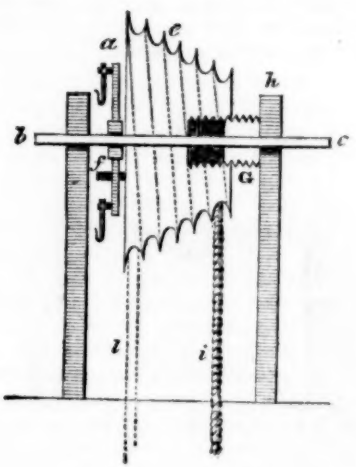
freely on the ends of this bar; C, is a short bar, or stop, projecting from the frame of the machine, on which the hook is intended to catch. When the bar revolves at a moderate rate, the hooks constantly hang down by their own weight, and do not touch the stop C; but when it revolves with a dangerous rapidity, the centrifugal force will cause the hooks to diverge from their pendant position, and one of these catches hold of the check-bar C, as shown by the dotted lines, and the machine is, of course, instantly stopped.

The editor of the Register of Arts remarks, that the instrument might be applied to cranes, and other machinery, and that it would be a decided improvement to give some degree of elasticity to the check-bar, to lessen the shock from sudden stopping. The succeeding communication resulted from the hint thus thrown out.

Improved mode of making the Centrifugal Check-Hooks, invented by Edward Speer.

TO THE EDITOR OF THE REGISTER OF ARTS.

SIR—You have inserted a description and engraving of Mr. Speer's centrifugal check-hooks, and have concluded the description with a remark, that some degree of elasticity should be given to the check-bar, in order to lessen the shock occasioned by the sudden stopping of the machinery. The subject of my present communication is a plan by which this defect would be obviated, and at the same time another decided advantage would be gained, which is, that when the velocity of the revolving wheel was so far reduced as completely to set danger aside, the machinery would not stop, but would recommence motion, always checking itself when it should have acquired a certain velocity.



In the above drawing, *a* is a section of Mr. Speer's check-hooks, (as described in the last article;) the bar to which the hooks are suspended, turns with the axle, *b c*. *e* is a conical pulley with grooves cut in a spiral direction, as represented in the section; this pulley turns on the axle, and not with it like the bar *a*. Out of this pulley at *f* proceeds the check-bar. G is a screw fixed to the frame *h*, which fits into the pulley *e*, so as to enter it as soon as the pulley is made to revolve in the same direction as the bar *a*. *i* is a cord fixed to the pulley *e*, so as to be wound round all the grooves when the pulley is turned; to the end of it is a fixed weight, the size of which must be regulated according to the velocity with which the machine is required to work.

Now it is evident from an inspection of the above plan, that when the check-hooks, by the too rapid revolution of the check-bar *a*, should have diverged so far from their natural position as to catch the check-bar *f*, the pulley *e* would be drawn round in the same direction as the bar *a*, and evidently would wind the weight suspended by the cord *i*, until the cord had reached the outermost groove as at *l*, when the machinery would be reduced to a proper velocity; at the same time the pulley *e* would be so far drawn back by the screw G entering it, as to have drawn the check-bar *f* out of the reach of the check-hooks, when the machinery would proceed in the regular way, and the cord *i*, by means of the weight attached to it, would, by turning round the pulley *f*, resume its original position, as shown at *i*, being always ready to regulate the machinery when the check-hooks should have so far diverged from their natural position as to catch the check-bar *f*.

Yours, &c.

W. Leay.

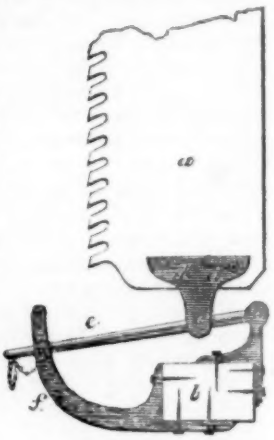
A Steam Horse.

In the London Journal of Arts, for February, Mr. Newton makes some remarks on the subject of steam coaches, and avers that, notwithstanding the people of that metropolis are constantly upon the look out for these vehicles, there is not at present in existence, nor in any tolerable state of progress, a steam coach likely to be applied to any public service; and that he shall continue so to declare, until one can be made to run *one stage of five miles, in the course of one hour, without stopping;* but that there does not appear to be any probability that Gurney's, or any other of these vaunted locomotive vehicles, will perform so very moderate a feat. The following are his concluding remarks.

"Among our numerous correspondents upon this subject, one gentleman, well known in the inventive world, tells us that he perfectly agrees with us in opinion, that steam coaches are impracticable, but that he has something coming forward which will supersede their necessity; he is about to complete a STEAM HORSE."

A new and easy mode of fixing a frame Pit-Saw.

As a frame saw can be made thinner than a common pit-saw, it is in many instances important to employ it, to prevent that loss of timber, in valuable woods, which is produced by a thick kerf. The fixing and unfixing of a frame saw is, however, a frequent objection to its use; the subjoined plan has been devised to obviate this objection.



a, is the lower end of a frame saw; *b*, a section of the lower bar of the frame; *c*, the holdfast; *d d*, the two pins; *e*, the lever; *f*, a double arch piece with holes, the lever working between the two parts of the arch, the saw can be held to any degree of tightness, by a small peg fastened by a chain to the end of the lever.

To shift this saw, press the lever, take out the peg, lift up the lever, take out the pins *d d*, and the saw being lifted and swung back, can be put in the next cut, and fastened again.

AMERICAN PATENTS.

List of Patents granted in the United States, from November 15th, to December 31st, 1827.

FOR INVENTIONS AND IMPROVEMENTS.

In the making of ornamental hair combs, termed by the manufacturer, *side and neck combs;* Uriah Bailey, West Newbury, Essex County, Massachusetts, November 15.

In the hydrostatic steam cradle, for raising and transporting ships, or vessels, of any size or weight, over bars and shoals; Charles Miner, of Lyne, Conn., November 16.

In rolling the backs of tortoise shell combs; Nathaniel Bishop, of Danbury, Conn., November 17.

In an invention, or machine, by him called the frame chain; David Leslie, of New York, November 19.

In making leather water-proof; David Kizer, of New York, November 19.

In the mill for sawing timber, called the reciprocal saw mill; William Kindall, junr., of Waterville, Kennebeck County, Maine, November 23.

In the machine for washing clothes, and shelling corn; Benjamin Rice, of Denmark, Lewis County, New York, November 23.

In a machine for using the escape steam of an engine; Davis Embree, New Richmond, Clermont County, Ohio, December 3.

In the machine for turning rake and hoe handles; William Shepardson, and Josiah C. Sperry; the former of Hamilton, Madison County, and the latter of Camden, Oneida County, New York, December 3.

In the vest spring, and stiffener; James G. Shute, Boston, December 5.

In four wheel carriages; Theodore Brooks, and Daniel W. Eames, Rutland, Jefferson County, New York, December 6.

In the copper puncher; William Ballard, Boston, December 6.

In a machine called the windlass pegging jack; Samuel Nourse, Danvers, Essex County, Massachusetts, December 8.

In breaking flax; Henry Schoonhoven, town of Pulteney, Steuben County, New York, December 11.

In *hanging or slinging* the fore, main, and mizen yards of a vessel; Isaac Carver, junr., Prospect, Waldo County, Maine, December 11.

In the saw mill; Benjamin Overman, Greenboro, North Carolina, December 11.

In the grist mill; James Robison, of Buckskin Township, Ross County, Ohio, December 11.

In warming and heating rooms; Archibald M'Allister, and John Iggett, of Salem, Washington County, New York, December 15.

In the common hand rake, for raking hay; Ambrose Foster, of Auburn, Cayuga County, New York, December 19.

In cutting fur; Machael Petre, of Womelsdorf, Berks County, Pennsylvania, December 20.

In the tread wheel; Cornelius Watson, of Addison Township, Galliopolis County, Ohio, December 22.

In propelling vessels; Elijah Bryan, of New York, December 22.

In distilling; James Lusk, of Butler County, Ohio, December 22.

In spectacles, and single eye-glasses; S. Newton, Washington, D. C., December 22.

In the Barshear plough; Eli Pugh, of Chatham County, North Carolina, December 24.

In the machine for turning rake handles; Anson Sperry, of Rotterdam, Schenectady County, New York, December 26.

In a machine called the sliding-plane turner; Jonathan Sparrow, of Portland, Maine, December 26.

In spinning cotton; John C. Dewees, of Mason County, Kentucky, December 28.

In the mortising machine; Abel Greenleaf, and Hollis Amidon, of the town of Mexico, Oswego County, New York, December 28.

In cast-iron sheeves for shipping; Frances Seymour, administratrix of Benjamin Seymour, of Plymouth, Massachusetts, December 29.

In the plough; Bird Murphy, of Union District, South Carolina, December 31.

In the saw mill; William Kindall, of Waterville, Maine, December 31.

ENGLISH PATENTS.

List of patents for New Inventions, which passed the Great Seal, in England, from November 22, to December 22, 1827.

To Robert Wheeler, brewer; for an improvement or improvements on, or in, refrigerators for cooling fluids—November 22.

To William John Dowding, clothier; for certain improvements in machinery for rollering wool from the carding engine—November 22.

To John Roberts, engineer, and George Upton, oil-merchant; for certain improvements on Argand and other lamps—November 24.

To John Alexander Fulton, spice merchant; for a process of preparing or bleaching pepper—November 26.

To Joseph Apsey, engineer; for an improvement in machinery to be used as a substitute for the crank—November 27.

To Joshua Jenour, jun., gentleman; for a cartridge, or case, and a method of more advantageously enclosing therein shot, or other missiles, for the purpose of loading fire-arms, and guns of different descriptions—November 28.

To Thomas Bonner, merchant; for certain improvements on safety lamps—December 4.

To William Fawcett, engineer, and Matthew Clark, engineer; for an improved apparatus for the better manufacture of sugar from the canes—December 4.

To Robert Walter Winfield, brass founder; for an improvement or improvements in tubes or rods, produced by a new method or methods of manufacturing them, and in manufacturing the same, (with various other improvements,) into parts of bedsteads and other articles—December 4.

To John Meaden, coach maker; for certain improvements on wheels for carriages—December 4.

To Samuel Wilkinson, mechanic; for improvements in mangles, which he intends to denominate Ballman's patent cabinet mangle—December 4.

To Maurice de Jough, cotton-spinner; for an improvement or improvements in machines, adapted for spinning, doubling, twisting, roving, or preparing cotton and other fibrous substances—December 4.

To Thomas Tyndall, gentleman; who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of certain improvements in the manufacture of buttons, and in the machinery or apparatus for manufacturing the same—December 4.

To Daniel Ledsam, and William Jones, manufacturers; for certain improvements in machinery for cutting sprigs, brads, and nails—December 5.

To Joseph Robinson, brush-maker; for an improvement in the manufacture of brushes of certain descriptions, and in the manufacture of a material or materials, and the application thereof to the manufacture of brushes and other purposes—December 4.

To Paul Steenstrup, esq.; for certain improvements in machinery for propelling vessels; which improvements are also applicable to other purposes—December 11.

To John Harvey Sadler, mechanist; for certain improvements on power-looms, for the weaving of silk, cotton, linen, wool, flax, and hemp, and all mixtures thereof—December 13.

To Ralph Bewcastle, millwright; for a new and improved method of ballasting ships and other vessels—December 13.

To Robert Stein, gentleman; for an improvement in applying heat to the purpose of distillation—December 13.

To Frederick Benjamin Geithner, brass founder; for certain improvements on castors for furniture, and other useful purposes—December 13.

To Henry Peto, surveyor and builder; for an apparatus for generating power—December 13.

To Joseph Anthony Berrollas, watch manufacturer; for a method of winding up a pocket watch, or clock, without a key, which he calls Berrollas's keyless watch or clock; and also for a certain improvement, to be applied to his late invented detached alarum watch—December 13.

To Andrew Motz Skene, esq., a lieutenant in our royal navy; for an improvement or improvements in the mode of propelling vessels through the water, and for working under-shot water mills—December 15.

To John Lee Stevens, merchant; for a new or improved method or methods of propelling vessels through or on the water, by the aid of steam, or other means or power; and for its application to other purposes—December 18.

To Thomas Tyndall, gentleman; who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of certain improvements in machinery to be employed in making nails, brads, and screws—December 18.

To John George, esq., barrister-at-law; for an invention for preserving decked ships or vessels, so as to render them less liable to dry rot; and for preserving goods on board such ships and vessels from damage by heat—December 18.

To Thomas Stanhope Holland, esq.; for certain combinations of machinery for generating and communicating power and motion, applicable to propelling or fixed machinery, as also floating bodies, carriages, and other locomotive machines—December 19.

To William Harland, M. D.; for improvements in propelling locomotive carriages, &c.—December 21.

To Charles A. Ferguson, mast maker, and James Atlee, gent.; for improved masts—December 22.

To William Hale, merchant; for an improvement in propelling vessels—December 22.

NOTICES.

NEW ARRANGEMENT IN PUBLISHING AND DISTRIBUTING THE FRANKLIN JOURNAL.

The publishing office of the Franklin Journal, will, hereafter, be at the Hall of the Institute. The Editorial department will remain unchanged, but the work has become the property of the Franklin Institute. Mr. William Hamilton has been appointed *Actuary*, and all communications relating to the subscription to, or the distribution of the Journal, should, hereafter, be addressed to him at his office. Communications for insertion, or relating to the objects of the work, may be sent either to the Editor, or to the Actuary.

The distribution of a widely extended periodical, requires the undivided attention of an individual; and it is believed that the new arrangement will insure a more prompt and efficient management in this particular, than has hitherto been found to be practicable, notwithstanding the care of the late agent. Although the principal publication office will be at the Institute, Mr. Dobson will continue to aid in the diffusion of the work, and will communicate to the Editor, or to the Actuary, whatever concerns its interests.

To Correspondents.—Mr. Bakewell's paper 'on loss of power,' Belidor 'on an improved steam valve,' and C, 'on the mode of communicating power from a water wheel,' require the aid of the engraver, but are intended to appear in our next number.

When drawings are sent, we should be obliged by their being made to such a scale, as will render their reduction unnecessary. We could then place them all at once in the hands of the engraver, and frequently avoid delay. This remark is intended for those who draw as well as our correspondent C. From those who are unskilled in the graphic art, we look for such delineations only, as shall aid us in understanding their purposes.

New Mode of Refining Sugar.—The Editor has received the remarks of a subscriber upon this subject. It had previously engaged his attention, and he has determined to publish, at large, Howard's process, which has been given by Mr. J. J. Hawkins, who was the engineer to whose management the establishment was committed. If the engravings can be completed, the first portion will be presented next month, otherwise it shall appear on the first of June.

We have some other communications which are under consideration; some which we have not found time to revise, and some which are incapable of revision. When plans of machinery are offered, which we think absurd, we do not deem it necessary to put the projectors to the expense of postage, for the objections which we might urge against their *discoveries:* were we to do so, the liberality of inventors might be put to a severe test, and we apprehend that our reward, in most instances, would be a charge of ignorance, for not being able to perceive what is so very clear to others.